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BRITISH GRAHAM LAND EXPEDITION, 1934-37

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THIS paper is a narrative of the expedition, describing in a general way our plans and travels, and the country which we were able to explore. The new problems and theories in the realms of geology, biology, and meteorology are being described separately in future issues of this *Journal*. It must be remembered that throughout our time in the Antarctic the expedition's scientists were doing their best to make the most of every opportunity that was offered. Often the general needs of the expedition, such as unloading cargo, building the houses, cooking the meals, and a small share in the maintenance work, made scientific work impossible; this was quite unavoidable with a small personnel such as ours. But even when on watch at sea they could sometimes combine science with seamanship by observing the distribution and habits of ocean birds, or trying to interpret the rock and ice formations on the islands as the *Penola* threaded her way among them. Naturally however they were always delighted when their general duties were done and they were free again to carry on their scientific work.

The exploration of south Graham Land was a problem considered by H. G. Watkins after his return from Greenland in 1931, but he was unable to raise the necessary funds, and was forced to abandon the project. He returned to Greenland, accompanied by Riley, Chapman, and myself, and was drowned there. Thus it fell to the lot of his followers to carry on the work in the south. On returning to England at the conclusion of the Greenland expedition, I immediately set about organizing one to Graham Land. Four of my old companions from the Watkins expeditions agreed to join me: W. E. Hampton, who came as second-in-command and chief pilot; Surgeon Lieutenant-Commander E. W. Bingham, Royal Navy, doctor and in charge of dogs; A. Stephenson, chief surveyor and meteorologist; and Q. Riley, whose jobs were many, as he was commissariat officer, meteorologist, and in charge of the expedition motor boat. The expedition numbered sixteen altogether and was divided into two parties—the shore party and the ship's party. The

four mentioned above were members of the shore party; the others were the Reverend W. L. S. Fleming, chaplain and geologist; Lieutenant I. F. Meiklejohn, of the Royal Corps of Signals, wireless officer; J. I. Moore, engineer and surveyor; and B. B. Roberts, ornithologist. The ship's party consisted of

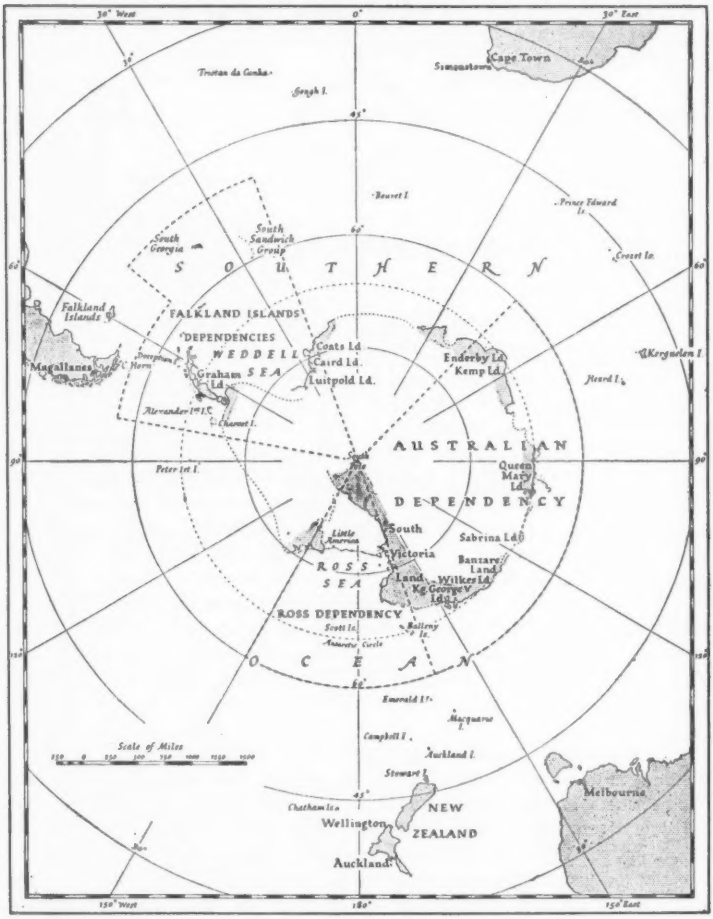


Fig. 1. The Antarctic continent as known in 1934

Lieutenant R. E. D. Ryder, Royal Navy, captain; Lieutenant-Commander H. Millett, Royal Navy, chief engineer; J. H. Martin, first mate; Captain L. C. D. Ryder, of the Royal Norfolk Regiment, second mate; G. C. L. Bertram, biologist; N. Gurney and V. D. Carse, sailors.

The general map of the Antarctic (Fig. 1) shows the position of Graham

Land, on the south side of Drake Strait, directly south of Cape Horn. It can be clearly seen that the part of the Antarctic coast which lies to the south of Australia and South Africa has been well explored, especially the Ross Sea area, where Scott, Shackleton, Amundsen, and Byrd all carried out their work; but this other area in western Antarctica had been left practically untouched, mainly because of the difficulty caused by heavy pack-ice in reaching the coast by ship. The area in which we proposed to work is British territory, and is called the Falkland Islands Dependency.

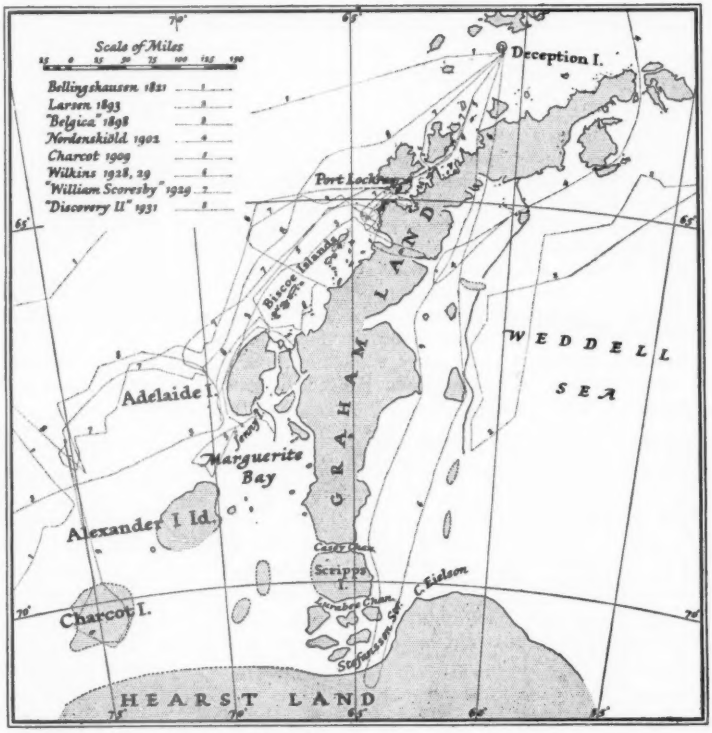


Fig. 2. Graham Land and routes of previous explorers

Apart from the exploration of northern Graham Land no one except the German explorer Filchner, in 1912, had succeeded in landing anywhere on what was thought to be the Antarctic continent or its bordering shelf-ice in the Dependency. Filchner landed in the south-east corner of the Weddell Sea, but was unable to carry out any exploration on land. Apart from this effort, enough ships, including Shackleton's *Endurance*, had failed to penetrate to the southern limit of the Weddell Sea to make it obvious that to try to push south on this side of Graham Land was quite impracticable.

But if one considers the west side, Fig. 2 shows the tracks of the expeditions which have worked along this coast south of latitude 65°. North of this latitude, the coast is easily accessible, and has been known to whalers and explorers for many years. Only two ships have succeeded in penetrating inside the Biscoe Islands; these were Charcot's *Pourquoi Pas?* in 1908 and the *Discovery II* in 1931. Whalers working from Port Lockroy may have come inside the Biscoes, but their reports are too vague to be relied upon.

When aeroplanes became practicable for polar travel, Sir Hubert Wilkins made the first Antarctic flight in 1928 when, in a magnificent effort, he flew from Deception Island 600 miles south, and so penetrated the vast unknown region of southern Graham Land. His route is shown on Fig. 2, and in the *Geographical Review* (xix (1929) 367) he stated:

> "At 12.50 I noted in my log 'we are now quite certain that Graham Land is not connected with the mainland continent.' We felt sure of this before, but at this point it could be distinctly shown in a photograph. We named the cape at the north side of the channel Cape Walcott; the channel Lurabee Channel; and the islands to the south the Finley Islands. In a few minutes we could see that the group of islands did not extend very far. They were divided by level, smooth ice. There appeared to be a group of six or more of these islands scattered in a wide strait. We could not clearly define their outlines because we were then flying at 2000 feet, to which height we had descended for observation of the snow surface. Beyond the islands extended a level strait, and farther south a smooth slope, wide and unbroken, reached southward. It was not marked by even a speck or a shadow and would not show on a photograph. We called the strait Stefansson Strait, and the land beyond it Hearst Land."

Again in 1929, while using the Discovery Committee's ship *William Scoresby* as a base, he flew round Charcot Island. Of this flight he says: "From where we first reached land about latitude 69° 45′, longitude 74° 55′ W., Rothschild Island bore 70° true. Far to the east we could see two new islands. . . . In the neighbourhood of the two new islands and south of them we could see a few icebergs fast in the shelf-ice" (*Geogr. Rev.* xx (1930) 374). On the strength of Sir Hubert Wilkins' reports the map took shape as it is shown above.

As has been said, it is unpractical to navigate in the Weddell Sea, but Mr. Wordie pointed out that Wilkins' report of Casey Channel, Lurabee Channel, and Stefansson Strait opened up a new possibility for an expedition to work as far as possible down the west side of Graham Land, establish a base somewhere in Marguerite Bay, and then travel by dog sledge through one of these channels, and so explore the Antarctic coast behind the Weddell Sea. Another party from the same base could explore to the west behind Alexander I Island and Charcot Island. This is what we planned to do.

In organizing an expedition the first essential is of course money, and in spite of generous support from the Colonial Office, the Royal Geographical Society, and many private donors our funds were very limited; as a result we had to economize in every possible manner. The greatest expense incurred by an Antarctic expedition is the ship. I proposed to cut this expenditure down to a minimum by buying a small sailing ship fitted with auxiliary power and running it entirely with amateurs—except for the captain and chief engineer,

The "Penola" in Port Lockroy, January 1935

Mount Français, Antwerp Island, from Port Lockroy

The "Penola" in winter quarters at the Argentine Islands

The Argentine Islands base, August 1935

Riley, Hampton, and Rymill in the house at the Argentine Islands

who were naval officers. Therefore the captain, although an experienced and efficient navigator, was virtually an amateur in sail. As we were contemplating a three years' voyage this scheme was naturally a formidable undertaking, and met with a great deal of disapproval and criticism from seafaring men. However I heard no difficulties suggested that I believed could not be overcome, and as it was a question of taking an amateur crew or not going to the Antarctic at all, there was no alternative.

On looking back on the expedition it is apparent that the amateur crew had obvious disadvantages in the beginning while they were still new to ships and the ways of the sea, but later they did their work well and safely under conditions which would have taxed the best professionals. Although educated men cannot be expected to have the same interest as ordinary sailors would have in dull maintenance work during the winter months which our ship spent in the Antarctic, they are far more adaptable to uncomfortable conditions and strange food. In fact I have the greatest respect for the only two members of the ship's party who were not specialists and were therefore called upon to do most of the dull, unpleasant work. If the occasion arose again I would not hesitate to adopt the same system, for judging by results it has proved itself to be a sound one. During the voyage, which lasted for two years and eleven months, this amateur crew, besides carrying out the maintenance work, which is always heavy on an old wooden ship, covered a distance of 26,896 miles: 15,496 under sail alone, 3,040 with engines, and the remainder under a mixture of the two.

Besides the ship our transport consisted of a small single-engined Fox Moth aeroplane, a motor tractor, and sixty-four sledge-dogs bought for the expedition by F. Spencer Chapman in Greenland. Unfortunately these dogs developed distemper on the way to the Antarctic, and all except fifteen died. Dog-sledging was to be our chief form of travel once we established our base, and it was essential to get more. As there was no time to send an experienced man from England to buy them, and there was no chance of getting more from Greenland, a new lot had to be bought hurriedly through an agent in Labrador. Although some of these were excellent animals, many were very poor, some even dying of old age while on the expedition.

At the beginning of September our ship, an old Britanny fishing schooner, rechristened the *Penola* after my home in South Australia, was ready to sail from the St. Katharine Dock, London. Hampton and Stephenson had left some months before by cargo boat for the Falkland Islands with the Greenland dogs and the greater part of our stores, while Bingham was waiting behind to bring on the new consignment of dogs from Labrador, which had not yet arrived.

We went down the Thames on 10 September 1934, and after a good trip through the Channel were soon out in the Atlantic. The amateur crew under the guidance of Ryder and Martin quickly became efficient enough to handle the ship safely, and after calling at Madeira and Montevideo we eventually arrived at the Falkland Islands, taking seventy-nine days for the passage of about 7000 miles from England.

Hampton, Bingham, and Stephenson were waiting for us, and two days

later Hampton and Bingham left with the dogs and a large part of our stores, including the aeroplane, on board the *Discovery II*, which had been lent by the courtesy of the Discovery Committee to carry some of our equipment to north Graham Land, so that when we sailed across the stormy southern ocean we did not have the added danger of being overloaded.

The *Penola* was not ready to leave the Falkland Islands until December 31, and on the first night at sea we had a serious misfortune which was to alter the whole course of the expedition. When we got clear of the islands we met stormy weather with a heavy sea, and Millett discovered that the engines were running out of line. We immediately turned back to investigate the trouble, and on reaching harbour under sail alone Millett found that it had been caused by the engine beds, which were made of unseasoned wood, warping while on the long, hot voyage through the tropics. The fastenings had come loose, allowing the engines a considerable amount of movement. We were now faced with two alternatives: either to carry out repairs in the Falkland Islands, which would mean missing the open season in Graham Land and not getting south until the next summer, or disconnecting the engines and carrying on under sail alone, reconnecting the engines again when we entered the sheltered waters in the channels of north Graham Land, and then carrying out repairs ourselves during the first winter. I chose the latter course, and we sailed again on January 5. The voyage of 900 miles across the southern ocean was uneventful, and we reached Port Lockroy, a harbour discovered by Doctor Charcot in 1904, on 20 January 1935, where we had arranged to meet Hampton and Bingham. They told us that owing to heavy ice the *Discovery II* had failed to reach Port Lockroy on her first attempt, and had left them for a month on Deception Island, an abandoned whaling station 150 miles to the north. They then made a successful attempt to reach Port Lockroy, and *Discovery II* had only left two days before we arrived.

As the *Penola's* engines were in no condition to work in pack-ice or a heavy sea until they had been repaired, I thought that our best plan would be to try to find a site for our base on the mainland somewhere near the north end of the Biscoe Islands. We would most probably find good winter ice forming in the channel behind them, which would allow us to sledge south by this route.

As soon as we arrived at Port Lockroy we made a reconnoitring flight, but found that there was no practical place on the mainland for a base, for the coast is fringed with a narrow belt of glaciers lying at the foot of the mountains, and these terminate along the shore in ice-cliffs 60 to 120 feet in height. For mile after mile the wall of ice is unbroken except at some headland where the rocky cliffs of a mountain spur plunge straight down into the sea. However we found a good place on the Argentine Islands (named by Doctor Charcot) 40 miles south of Port Lockroy, and within 300 yards of the place which we chose for our base site there was a sheltered cove making an excellent wintering harbour for the *Penola*.

Our house and hangar, which was all one structure, was a new departure for the Antarctic, for we decided on a two-storeyed building. The house consisted virtually of two large rooms each measuring 22 feet by 15½ feet, with a porch in front. The downstairs room served as a workshop, kitchen, and

View west from the head of Beascochea Bay

Sounding gear in Beascochea Bay

Aerial view of Chavez Island, with mainland in the background

dining-room, with one corner partitioned off to form an office for Meiklejohn's wireless. There was no ordinary heating stove but an Aga cooker, which though insulated gave ample warmth except in the coldest weather, when we used two petrol heaters as well. A ladder resting against an open hatch in the ceiling led to the living-room and sleeping-quarters above. This upstairs room had walls 4 feet high and a steeply pitched roof which gave ample head-space over most of the room. The house had double walls insulated with asbestos-reinforced aluminium foil, a highly reflecting metallic material which proved most satisfactory. Besides lining the walls and roof with it we covered the ceiling of the downstairs room, which made the room much lighter and had a very cheerful modernistic effect.

We soon established the base on the Argentine Islands, and on 28 February 1935 Hampton and I made a flight along the coast to Matha Strait with the idea of seeing if there was any possible sledge route across to the east side of Graham Land. We flew south for 150 miles, but everywhere the central plateau was guarded by a great rock-cliff, making a crossing impossible except perhaps for a short climbing expedition. There was therefore little we could do except local surveying from the motor boat and biological work, until the ice in Grandidier Channel, which lies between the Biscoe Islands and the mainland, froze over. The period of waiting was a long one, but we were all fully occupied: the ship's party with the repairs to the engine beds and the general work of laying up the ship for the winter; while the shore party was kept busy with the scientific work, looking after the motor boat, and handling the aeroplane, which made many short flights, mainly for helping the scientists with their work. Both parties combined in sealing operations, and some ninety seals were killed and stored in an ice-cave for use during the winter.

Bingham, who was in charge of the dogs, spent most of his time while on the Argentine Islands in supervising breeding operations and training puppies. With careful management he succeeded in increasing our pack from the original forty-five which landed in Graham Land to ninety-eight; in fact 56 per cent. of the dogs working in the second sledging season were bred and trained on the expedition.

By the middle of July the new sea-ice between the Argentine Islands and the mainland was bearing well enough for us to sledge on, but was far from solid and might be broken up by any strong wind. If however we could once reach the mainland we believed that the ice in the bays would be good; there would thus only be treacherous going round the points, and a reconnoitring flight of some 50 miles down the coast showed the ice in Grandidier Channel to be bearing well. Our plans at this time were that one party would try to sledge to the north end of Adelaide Island, 140 miles from the base, there to establish a landing-ground for the aeroplane. They would travel over sea-ice close to the mainland and should be able to camp each night in the back of a bay, or on one of the numerous small islands along the coast. Once the landing-ground was established, Hampton would fly 2000 lb. of sledging provisions down to it. This would involve about five flights, and after the second one the sledging party which had established the landing ground would carry the stores on another 70 miles to Jenny Island. Then another party would leave the base, and after combining with the advance one, push on to try to explore

the unknown country south of Marguerite Bay. This journey should be completed before the ice broke up in Grandidier Channel; and then, as the ship's engine beds were now repaired, the whole expedition would be able to move farther down the coast as soon as the ice broke up, and establish a new base as far south as possible.

On August 18 Bingham, Moore, and Martin left to establish this advanced landing-ground for the aeroplane; Ryder and I left at the same time to accompany them for the first 50 miles and leave a depot intended for the return sledge journey, and also to mark out an emergency landing-ground. On August 22, after reaching our objective, I returned with Martin and Moore. Moore was obliged to come back on account of slightly frost-bitten feet, and Martin returned as it was found that the advance party could travel more efficiently in cold weather with only two men in a tent instead of three.

We arrived at the base on August 24, and two days later Hampton and I flew south again. I wished to show Hampton the emergency landing-ground, and we also hoped to make contact with Bingham's party. We picked up his sledge tracks at the depot and followed them south until we neared Pendleton Strait, about 70 miles from the base. Here we found rotten ice and completely open water, and could see from the tracks that the sledgers had wandered about trying to find a way through the maze of islands. It was obviously impossible to sledge beyond this point, and after looking for their camp on the islands we followed the sledge track north again and eventually found Bingham and Ryder camped on a small island 20 miles south of the depot. The ice looked very thin but Bingham signalled to us that it was safe for landing. When we came down he told us that while they were trying to get south the ice was steadily deteriorating in spite of zero temperatures. This was evidently caused by a strong current coming in at Pendleton Strait. The season was too advanced to give us any hope of improvement in the ice conditions, and we had to abandon any idea of getting south of this point. Therefore we decided that Bingham and Ryder would travel slowly northwards, making an accurate survey of the coast and off-lying islands, while Stephenson, Fleming, and I would start south from the base and connect with them. But before the survey could begin we would have to fly a wireless set for time signals down to Bingham's party.

This was done a few days later, and on September 1 Stephenson, Fleming, and I left the base to begin our end of the survey, which was really continuous with that done by Stephenson round the Argentine Islands and mainland opposite. This enabled him to start from a measured base and he was also helped by another base which he had measured in Beascochea Bay, a large fjord some 20 miles south of the Argentine Islands which had already been surveyed during the last week in August.

We worked slowly south, being much hindered by rotten and young ice, which made travelling difficult but interesting. Even in winter we found it impossible to land on the mainland except at one or two isolated places, for the promontories were fringed with narrow glaciers terminating in ice-cliffs in places over 100 feet high. Farther into the bays these narrow glaciers gave place either to broad crevassed ones or to rock-cliffs where the mountains came to the water's edge. The backs of the bays terminated in steep valley

glaciers which flowed down from a large glacier running parallel to and at the foot of the great plateau scarp, and fed by the tremendous icefalls which in places pour over the 4000-foot sheer rock wall of the central Graham Land plateau.

Stephenson determined astronomical positions at frequent intervals, and from these positions took both vertical and horizontal angles with the theodolite. Between these theodolite stations the detail was filled in by plane table. By this means we were able to determine the main outline of the coast and fix the positions and heights of the prominent mountains lying between the plateau edge and the points of the promontories. In addition we were able to fix the summits of a number of islands out to sea, their actual shore-line being difficult to determine in the winter time. Such points as we were able to fix served however as very useful controls for further work in the summer, when two flights were made over the islands and their general distribution sketched in by Ryder; and then when *Penola* eventually motored down the channel between the Biscoe Islands and the mainland, soundings were taken and as much detail of the islands filled in as time permitted.

Our map (see folding plate) covers a very broken-up part of the coast with great bays cutting into the mainland and a multitude of off-lying islands, and we do not claim that it is an accurate map of the whole area. The mainland and islands lying close to the mainland or to *Penola's* route can be considered as accurate on the present scale (1/750,000) and for the rest of the map only the outer limits of the groups of islands have been fixed, the details of the islands themselves being only sketched in from the aeroplane.

We finally met Bingham and Ryder on September 11, and both parties returned to the base four days later with the survey completed. There was now little we could do until the ice opened up enough to allow the *Penola* to work south, and we could establish our new base.

The wood in our old house was too swollen with the damp and too well put together for us to take it to pieces in a fit condition to use again. So on 3 January 1936, after we had freed the *Penola* by cutting the ice out of the creeks, she left for Deception Island to collect the necessary timber from the abandoned whaling station there. While the ship was away Stephenson, Fleming, and I made a short sledge journey into the interior of Graham Land, starting at a point opposite the Argentine Islands. We followed much the same route as Doctor Charcot's party had done in 1909 and were stopped by heavily crevassed country in much the same place. I believe it would have been possible to reach the plateau if this had been the main purpose of the expedition, but the country was so badly crevassed that we would have been certain to have lost dogs and possibly sledges also, a thing which it would have been pointless to risk on a journey of minor importance when all our available transport would be so necessary in the following year.

The *Penola* got back from Deception Island on 27 January 1936 with the wood for building our new house, and all available people immediately set to work cutting the main timbers, while the ship's party prepared for the voyage south.

For the second year which we were now about to spend in the Antarctic a change in the plans for the ship's party and in the personnel was necessary,

for during the winter Roberts had been suffering from recurring appendicitis, and Bingham and I decided that it would be unwise for him to spend a second winter in the Antarctic. Therefore we decided that when we had established our new base the *Penola* would have to return to the Falkland Islands, where Roberts could have his appendix removed. He would change places with Bertram, the latter coming on the shore party and Roberts taking his place in the ship's party.

We now had a year's experience in Graham Land, and from the knowledge we had gained it seemed that the most ice-free time would be March or April. I do not advocate pushing a ship into the Antarctic pack as late in the year as this, but navigating in the pack-ice must not be confused with coasting along west Graham Land, where the dominant wind blows from the north-east and east, tending to carry the ice away from the coast as soon as it breaks out. As this is not until the end of the summer, the later one can leave the better; but there were many other considerations besides the ice for us to take into account in deciding when to leave the Argentine Islands. We knew nothing of the coast south of Adelaide Island except that we expected to find Casey Channel in latitude 69° 40′. Some time would therefore probably be spent in trying to find a site for our base and, when found, a great deal had to be done before the freeze-up. I thought that if we left the Argentine Islands in the middle of February we could reckon on being in Marguerite Bay early in March. Doctor Charcot had reported a possible anchorage for a small ship in a group of islands off the south end of Adelaide Island, and these islands, if they proved safe, would make an excellent place to keep the ship while the aeroplane scouted farther south.

As no ship had, to our knowledge, travelled inside the northern Biscoes, we were keen to make the attempt; but before we could do this it was necessary to make a reconnoitring flight to see what the ice was doing, and also to find sunk reefs and any possible harbours.

The weather after the *Penola* returned from Deception Island was bad for some days, but on February 12 it was a little clearer, and Hampton and Ryder flew south inside the Biscoes. Soon after they started the clouds settled down again, and although they got some 70 miles to the south they saw very little, and when Hampton was forced down until he was flying level with the tops of the largest bergs he decided that it was wise to return. Next day was better. They made a successful flight and found that most of the winter ice had left the channels behind the Biscoes, but that the south side of Matha Strait and the fjords running south from it were still blocked. They also found a possible anchorage for the *Penola* about 70 miles south of the Argentine Islands which made a good place for us to stop the first night.

We set out on February 16, leaving Hampton and Stephenson behind to fly the aeroplane down when they received a wireless message from us to say that we had arrived at Charcot's islands and that flying conditions were good. The decks of the little ship were piled high with cargo, and on top of everything else there were seventy-five sledge-dogs chained in family groups, besides several crates of puppies. It was a beautifully sunny day with a light following breeze, and we reached the anchorage which Hampton and

Ryder had seen from the air after a most successful time surveying and sorting out the many small island groups.

We were held up here by bad weather for four days, but on the morning of the 20th the weather was better; we put out to sea through Pendleton Strait, and three days later rounded Adelaide Island. We were now in the north of Marguerite Bay, where there was very little heavy ice, but a few miles to the south we could see an irregular white line which warned us of the proximity of pack-ice; how heavy it was we could not yet tell. On approaching the islands we followed our usual procedure of stopping the ship and sending a motor boat ahead to sound out the approaches and anchorages, if any. On this occasion, after sounding several places which were too shallow, we eventually found a suitable harbour with just enough water to let the *Penola* in. While entering these little rocky harbours the motor boat, working as a tug, proved most useful for manoeuvring the ship round sharp corners.

As soon as we arrived Meiklejohn started sending weather reports to Stephenson, and he and Hampton flew down to us on February 22, covering the 220 miles in two and a half hours. They came down inside Adelaide Island and found the channel very much narrower than they had expected from the existing map. On the day after the aeroplane arrived there was a strong north-east wind which made flying impossible, but the day after that was bright and sunny, and Hampton and I prepared to fly on what promised to be the most interesting flight which we had yet made, as we hoped to get well beyond Charcot's farthest south along this coast. The brash ice was thick round the islands and we had to taxi well over a mile before we could find a stretch of water clear enough to take off from. As we rose above the bergs we could see Alexander I Island showing up clearly against the cloudless sky. When we reached a height of 2000 feet, we stopped climbing and steered a course for the entrance of Charcot's Neny Fjord. The pack-ice which we had seen from the *Penola* proved to be last winter's, still breaking out of Marguerite Bay in the form of small floes fairly loosely packed together through which the *Penola* would be able to pass without much difficulty. After flying for a few minutes, we saw a shore lead several miles wide extending south as far as we could see. As we flew on we were surprised to see what appeared to be a great mountain chain connecting Alexander I Island to Graham Land. We could not be at all certain of our discovery for, as so often happens in this region, although the day appeared bright and sunny with a cloudless sky, in the distance there was a thin mist, so thin that it looked only a few shades paler than the clear sky, and was almost imperceptible until one realized that it was blotting out part of some feature that one was actually examining. The mountains appeared to us to be 90 or 100 miles away, and we could see great peaks showing vaguely above the mist which completely blotted out the lower levels. This was the first new land we had seen, but we would have to wait for a clearer view before we could be certain of our discovery.

After following the open land to a position just south of Neny Fjord, we found that it stopped abruptly at much more solid ice, and a few miles farther on we were flying over ice practically unbroken except for one or two small leads. We decided that the *Penola* could force her way through it, so we circled back and started examining the coast for a base site. We saw that

Neny Fjord was really a glacier-filled valley, with only a small fjord at its mouth, but there was an island about 2000 feet high some 4 miles off the mainland, and the channel between was dotted with small ice-free islands and submerged reefs. The large island and most of the small ones had raised beaches with several good base sites. The safest anchorage appeared to be a crescent-shaped bay on the east side of the large island. After satisfying ourselves that we had found a possible anchorage for the *Penola*, and that she could not get any farther south, we flew back the 60 miles which separated us from her. When we arrived, Hampton took off again with Ryder to show him the position we had chosen, and to let him make a sketch-map of the sunk reefs which were fairly numerous along the coast.

In the evening Hampton and Stephenson took the aeroplane over to a sheltered bay where they could camp until we told them of our arrival. This bay was a most attractive place where the aeroplane could lie safely at anchor while Hampton and Stephenson lived in a tent on shore. The aeroplane carried a small collapsible rubber boat which made it possible for her to work as a separate and entirely independent unit. We were under way by five o'clock the next morning and, after the *Penola* had pushed her way easily through the bay ice, we arrived at the anchorage we had seen the day before. Meiklejohn wirelessed to Stephenson as we were approaching it, and while we were putting out the mooring ropes the aeroplane arrived.

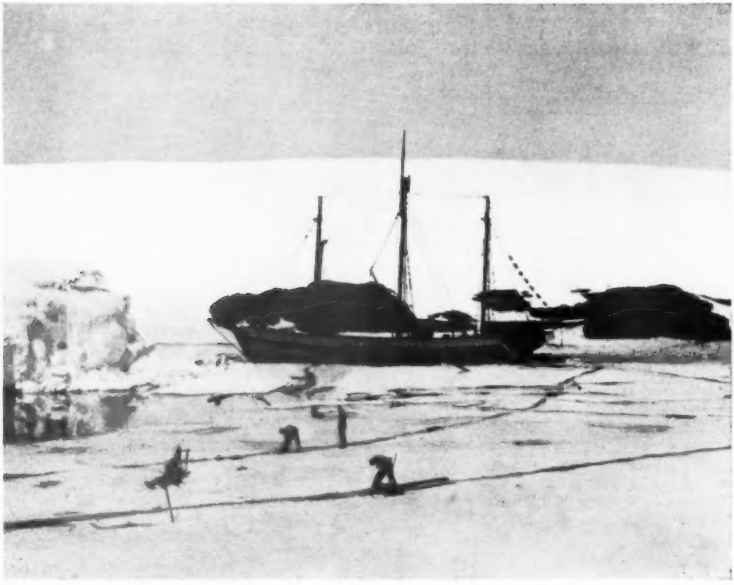
In the morning we cruised round in the motor boat looking for the best base site, and eventually found a good raised beach, facing a reasonably sheltered harbour. The motor boat towed the *Penola* over and we soon had her moored in her new berth. Unloading started at once, and in spite of high winds and snowstorms this was finished in four days; and while the shore party started building the house the ship's party got ready for their voyage back to the Falkland Islands.

I hoped that by keeping the ship with us for some weeks we should be able to take a large depot of sledging provisions farther down the coast. On March 12 Hampton and I flew south over Marguerite Bay to see if this would be possible. But the ice was still unbroken and showed very little change. The weather during the flight was too bad to let us see anything of our new land and, after flying for a short distance over the pack, we returned.

The season was now well advanced and the snow was beginning to lie. We could only guess the time of the freeze-up, and I reluctantly let the ship's party leave on their long 1200-mile voyage back to the Falkland Islands. They sailed on March 12, while we of the shore party moved into tents and carried on building the house and collecting seals for winter food.

We had seen while flying that the high plateau with its cliffed edge, here about 5000 feet high, still continued, making land travelling impossible except for short climbing parties. There was little we could do in the way of dog-sledging until the sea-ice froze up sufficiently to make travelling possible. In the meantime we hoped to carry out two flights before the aeroplane was changed on to skis for the winter. The first of these would be to the south to get a good look at the new land, and the other to the north to the unknown fjord region east of Adelaide Island. Both of these flights would have to be short, for the plane was already overdue for an overhaul, and it had also

Ice pans in Penola Strait: October 1935 to January 1936



Cutting a channel for the "Penola" with ice-saws, December 1935

Moving from the Argentine Islands to the Debenham Islands, February 1936

"Stella" towing "Penola" into an anchorage

developed a leak in the crank-case which Hampton could not repair until the hangar was built; but he thought it would be safe to undertake two flights of not more than two hours each, which would make it possible to fly out a distance of 75 miles from the base. The day *Penola* left was gloriously fine. Hampton, with Stephenson as chief surveyor, prepared for the southern flight. They took off at 11.20 a.m. and flew out over Marguerite Bay for their allotted 75 miles. From their turning point they had a magnificent view and could see that Charcot's Berteaux Island was really a cape and Cape Pierre Baudin was a point in the mountains behind. South of Cape Berteaux, according to the existing map, the coast should have trended south-east towards Casey Channel; instead of this it formed a big bay, swinging round to the south-west. To the west of the fliers Alexander I Island, a precipitous mass 8000 feet high, extended to the south-east and ahead the two joined, completing the bay. The only sign of a break in the coast was what appeared to be a narrow fjord in the south-west corner of the bay. South of Cape Berteaux this bay was filled with shelf-ice, fed by gently sloping but crevassed glaciers which looked as though they should make a possible sledge route inland. South of this bay they could see ridges 5000 to 7000 feet high stretching away for at least 50 miles. Where Stefansson Strait fitted in we could not tell.

There was not another possible flying day until March 31, when the same two made the flight to the north. To the east of Adelaide Island Charcot had marked two channels; one we had already flown down, and this time Hampton and Stephenson flew up the one farther to the east. After some 30 miles it came to an end in steep rock walls and small branching fjords which finished in glaciers. They turned westwards and soon found a glacier-filled valley running north and south. They flew up this valley at a height of 6000 feet for 25 miles. On either side were mountains between 5000 and 7000 feet, while the glacier beneath them rose to about 4000 feet at its highest point. They eventually came out at one of the fjords leading into Matha Strait and saw the Biscoe Islands in the distance. Here they turned, and arrived back at the base at 6 o'clock in the evening. The sun was just setting and the spray that touched the floats and wings froze almost immediately.

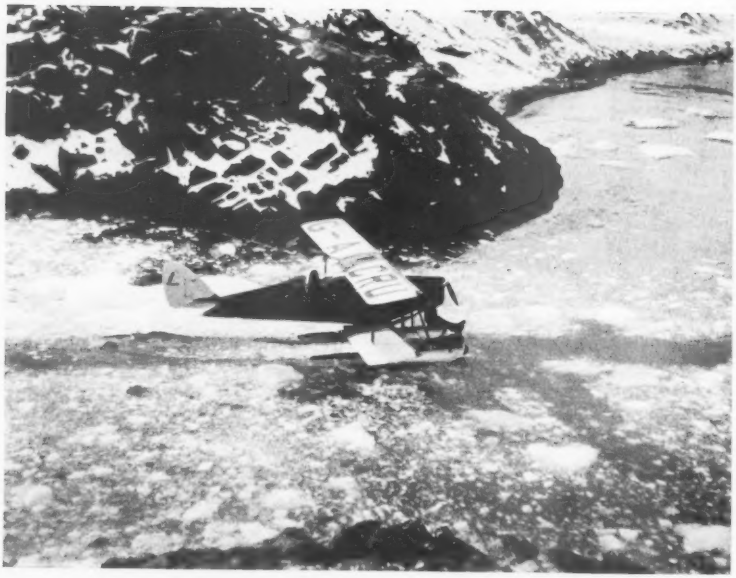
Now that we had completed these two flights we were in a position to work out a rough outline of future plans. Mr. Lincoln Ellsworth had, in November 1935, made a magnificent flight from Dundee Island to the Bay of Whales, and should have crossed the country somewhere to the south of the position which Stephenson and Hampton reached while flying on March 13. During the time Mr. Ellsworth had been in western Antarctica, we were in daily wireless communication with his ship the *Wyatt Earp*, and from the messages which we had received from her and also from those picked up from his aeroplane, we understood that he had confirmed Wilkins' Stefansson Strait and the existence of Hearst Land. I now telegraphed to my home agent, J. M. Scott, in London, asking him if he could let us know any details of Ellsworth's discoveries, and I received a telegram from him saying: "Ellsworth confirms Stefansson Strait but says it is only about 3 miles wide." Stephenson and Hampton had seen large mountain ranges extending far to the south beyond Marguerite Bay, so where Stefansson Strait fitted in was hard to imagine.

The flights had shown us that there was no chance of crossing Graham Land north of the shelf-ice, which was at least 70 miles south of our base. The first thing I had to decide was whether we would try to make one long journey to the eastward, crossing the mountains of Graham Land and then following the coast-line of the Weddell Sea, or whether we would explore the new country to the south, and also try to penetrate to the west behind Charcot Island as far as the western end of the Dependency, and then make a short journey to the eastward to survey some of the east coast of Graham Land without trying to reach the Weddell Sea. If we carried out the long journey to the east, everything else would have to be sacrificed to it, as all the expedition's resources and man-power would be used up in depot-laying and supporting parties. Sledging parties would have to lay a depot at the foot of the mountains in the winter, but we would not be able to make a flight across them to find a sledge route until we had a reasonable amount of daylight in the spring, and if we then failed to find a route our entire winter would have been wasted. But on the other hand, since our discoveries had shown that the whole distribution of land and sea to the south was so totally different from anything that had previously been reported by explorers, it seemed a great pity not to explore it thoroughly and clear up the many controversial points that would be sure to arise. Also to try to carry out the long eastern journey merely because it was our original plan seemed stupid, especially when it meant throwing away a chance of exploring this new and interesting country. We decided to give up any idea of the long eastern journey and planned that, as soon as the ice was safe for sledging, we would put on the shelf-ice about 70 miles south of the base a depot which would be used for crossing Graham Land, and also for a party consisting of Stephenson, Fleming, and Bertram to use while on a sledge journey round the bay. Bingham and I would make a long journey round the north end of Alexander I Island and then behind Charcot Island to the western end of the Dependency.

But before we could undertake this journey we would first have to make a flight round Alexander I Island to examine the state of the sea-ice. For, judging from our experiences not so very much farther north the previous year, this was a place where we might find the ice too thin and broken for sledging. Before we could do anything however we had to wait for the long transition period while the sea-ice was forming. This proved to be unduly long, as there were frequent gales, sometimes lasting for four or five days and often recorded on an anemometer at over 100 miles per hour. By June 1 we considered the ice was safe for sledging, but we decided to fly out over Marguerite Bay and have a good look at it before we started making depots. We waited until the ninth before we had a good day, and then after Hampton had made a short trial flight he, Fleming, and I flew over the bay-ice. We were of course at this time well into the winter darkness and only had a glimmer of twilight for a few hours at midday. The flight had to be short, and in fact it was rather a good effort on Hampton's part to undertake it at all with the difficulty caused by landing on a snow surface in the half light. The flight was very satisfactory as we found Marguerite Bay completely frozen over, with no open water to be seen anywhere. The ice all looked good and solid, with none of the grey patches which are a sign of thin ice. The temperature had been round

Debenham Islands with the "Penola" at anchor, March 1936

Building the second base on Barry Island (Debenham Islands)



Plane being towed into Barry Island

Aerial view of Terra Firma Islands with Cape Berteaux ten miles beyond in the background

about −30° F. for some time, and we now thought that the sea-ice, in spite of the strong off-shore winds, would be as safe as sea-ice ever is.

We left on the first depot journey on June 12. There were Bingham, Stephenson, Riley, Bertram, and myself with dog teams and Hampton with the tractor. All went well at first, but we only made slow progress owing to a very heavy surface and the short period of twilight. The night of June 16, after five days' travelling, found us about 40 miles from the base. The wind got up soon after we went to bed and blew an off-shore gale for thirty-six hours; the ice started to break up and a quick move to endeavour to reach some islands about 4 miles away had to be made. The tractor could not be moved from the camp and, together with the greater part of our depot, had to be left behind. After nine hours of hard travelling over loose ice-pans and high-pressure ridges, we at last succeeded in reaching the islands, where we had to wait for a week before the leads froze together sufficiently to allow us to make an attempt to return to the base. These islands we called Terra Firma.

The experience on this depot journey had clearly shown us that we could not go south again until the ice had withstood at least one really strong gale, and that we would have to wait until the snowfall had partly levelled out the worst of the rough ice for, although we had navigated it successfully with light sledges, it would be a very different business to try to get over it at present with heavily loaded ones. Although the ice to the south of the base had broken up so completely, that to the north had shown no signs of going out, and while we were waiting to start our long journey we decided to do the northern survey which we had planned for Stephenson and Fleming while they were waiting for Bingham and me to return from the western journey.

This northern survey would be a most interesting piece of work, as we should verify our previous aerial survey and also explore the complicated fjord system which lies to the north-east of Marguerite Bay. To carry out the survey we decided to work in two parties: Bertram and I with our two teams would make up one party and travel up Laubeuf Fjord, which lies between Adelaide Island and what we now knew to be the mainland, while the other party consisting of Stephenson, Fleming, and Riley, each with a team, would try to cover all the country from the base up to where Bertram and I would begin our work at the south end of Laubeuf Fjord. Each party hoped to sledge about 200 miles, and we expected to be away about three weeks.

We left on July 20, travelled together for the first 15 miles, and then separated, Stephenson's party stopping behind to start their survey, while Bertram and I hurried on to where we would start ours, 50 miles from the base. After being held up for some time by strong winds, we eventually arrived at the south end of Laubeuf Fjord on the sixth day out from the base. We turned to the north and hoped to reach the south end of Matha Strait, so connecting with our survey of the year before. By the night of the second day we had sledged 22 miles and camped just south of the point where the fjord narrowed down to only a few hundred yards wide. This was the sort of place where we expected to find thin ice, and the next morning we went forward cautiously. We were soon out on very rotten ice, and right in the narrowest part we were stopped by completely open water. As we could see well up into Matha Strait, we did not mind turning south again. So thin was the ice where

we turned that a seal who wished to get a good look at us pushed his head up several times through the ice where we had cut into it with our sledge runners.

As we travelled south again the north wind freshened, and by the middle of the afternoon it was blowing a gale. We were stormbound in our tent for three days with the usual 100-miles-per-hour wind, again on the sea-ice, as there was no chance of making a landing up the ice-cliffs; but this time the ice was solid and we had no trouble. The wind died down on August 2 leaving a really good travelling surface, and the dogs, pleased to be moving again, soon covered the 17 miles separating us from the south end of Laubeuf Fjord where we had started the survey. Here we spent a day getting astronomical sights and then sledged back to the base, covering the last 50 miles in two days. Stephenson's party arrived back two days later after a most successful three weeks of surveying and geologizing.

(*To be concluded*)

THE SHAKSGAM EXPEDITION, 1937

ERIC SHIPTON

Evening Meeting of the Society, 10 January 1938

THE main object of the expedition to be described in this paper was the exploration and survey of the unexplored country in the vicinity of the Shaksgam river, which is situated somewhere on the undemarcated frontiers of Ladakh, Hunza, and Sinkiang. Our principal interests lay firstly in the large unknown region of high mountain country which lies north of the main Asiatic watershed, between the Sarpo Laggo valley, and the Shimshal pass, and bounded on the north-east by the Shaksgam (about 1000 square miles in area); secondly, in the glacier system lying to the north and north-west of K^2; thirdly, in the portion of the Aghil range, west of that explored by Professor Mason in 1926. The two outstanding problems of this last area were the exploration of the lower reaches of the river discovered by Mason and named by him "Zug Shaksgam," and the discovery of its outlet; and the fixing of the geographical position of the Aghil pass. This being the fiftieth anniversary of Sir Francis Younghusband's journey across Asia we had an added incentive to visit this famous pass.

When, in September 1936, I obtained permission from the Government of India to undertake this project, I had intended that the party should consist of Tilman and myself with two Indian surveyors to work near our base and form a nucleus of accurate work to which we could attach our long, less detailed traverses. But on closer examination of the problem involved, I decided instead to invite Michael Spender to undertake the work of this detailed survey. Fortunately he was able to accept. The Survey of India most kindly contributed to the funds of the expedition. I also asked J. B. Auden, of the Geological Survey of India, to accompany the party, to assist in the exploratory work and to carry out as much geological investigation as he could. Seven Sherpa porters were recruited from Darjeeling, and owing to generous contribution to the funds of the expedition, we were able to engage for permanent employment four men from Baltistan. Apart from coolies employed temporarily as far as our base in the Sarpo Laggo, this completed the personnel of the party.

The next thing to be decided was how to tackle the problem of getting to the Shaksgam. Apart from attempting to reach it from China, three alternatives were open to us: firstly, to cross from the Karakoram pass to the head waters of the Shaksgam, and make our way down over the difficult glacier trunks which had defeated Mason's party in 1926; secondly, to cross the Shimshal pass early in the spring, and force a route up the lower gorge of the Shaksgam before the river became too high; and thirdly, to cross the main Karakoram range from the Baltoro glacier. The first two alternatives would probably have involved considerable difficulties with the river even early in the year, and would have rendered us liable to be cut off by the summer floods until late in the autumn. Besides which, the journey either to the Shimshal or the Karakoram pass is very long and costly, particularly early

in the year when the routes are not officially open. The difficulties involved by the third alternative were of a purely mountaineering character, and though we were likely to have considerable trouble in getting several tons of stores and equipment over a difficult glacier pass early in the year, I chose this route.

Our rough plan of campaign then was this: to reach the Baltoro glacier by the end of May; to cross the watershed with sufficient food to last the party for one hundred days after reaching our base below the snout of the Sarpo Laggo glacier; leaving a dump there, to cross the Shaksgam and spend as much time in the Aghil range as was possible without being cut off by the summer floods; and to return to the Sarpo Laggo about the middle of July and spend the remaining two months working on our other two objectives.

The chief difficulty which had to be faced in working out details of the above plan was the fact that, once across the main Karakoram range, the party would have to be entirely self-supporting for the whole period of its stay there—nearly three and a half months. This, and the enormous expense of transporting each effective load across the watershed, necessitated the rigorous exclusion of every ounce of superfluous equipment, and very careful rationing and the rejection of all delicacies which did not carry the maximum food value, or which interfered with a proper diet balance. Our food was based on a variety of Arctic sledging rations altered to suit the different conditions of supply and transport. We took a ·375 rifle with us, but although we succeeded in shooting a good deal of meat, we did not rely upon it as a source of supply.

We left Srinagar on May 5 and crossed the Zoji La to the valley of the Indus. Although that pass is only some 11,500 feet high it was still under deep snow and impassable for animal transport. In order to avoid avalanches we had to cross it with our twenty-five local coolies at night. We reached Skardu in Baltistan on May 18. Here we obtained supplies of rice, sugar, tsampa, kerosene oil, salt, ghee, and blankets for the coolies we were to employ above the Baltoro glacier. We were assured by the local authorities that as there had been a famine in Askole we would be able to obtain any quantity of flour at that village and at very cheap rates. Without being able quite to follow this curious reasoning we relied on the statement, as we were able thereby to avoid the expenditure of several hundred rupees in transporting two tons of flour from Skardu. The remaining five days' journey to Askole introduced us to three of the local methods of river crossing. The quietly flowing Indus was crossed in a huge wooden barge (said, I believe, to be the identical boat used in the days of Alexander the Great) which had accommodation for ponies; the fierce Braldu stream was negotiated on a raft of inflated skins—it was a sickening sight to watch the survey equipment and the load containing the treasury being swept down the rapids on this inadequate craft; and higher up, the river was spanned by two of those V-shaped rope bridges which I think are peculiar to these parts. This horror we were able to avoid however by a sensational rock climb along the face of the cliff which the bridges were designed to circumvent.

We reached Askole on May 24. Spender and Auden went ahead from here to carry out a large-scale survey of the snout of the Biafo glacier, in order to compare its present features with those that Auden had observed when he

Phot. E. E. S.

Peak above Trango glacier

Phot. H. W. T.

Skyang Kangri (Staircase) from Peak 6350 above K² glacier

K² from Peak 6350 *Phot. H. W. T.*

Porters at high camp above Trango glacier *Phot. E. E. S.*

had visited the glacier in 1933. On his return to Askole, later in the year, he repeated this work and so was also able to obtain some data about the behaviour of the glacier during the summer. Meanwhile Tilman and I bought and bagged two tons of flour, the great bulk of which was to be eaten by the coolies who carried it towards our base, and recruited 104 men from the neighbouring villages for transport work on this final stage of the journey. We agreed to pay them a rupee a day each and to give them bonuses according to the number of stages they were taken. We left Askole with this huge caravan on May 26. The whole success of the expedition now depended upon how far we could get these men, and it was essential that they should be induced to go as fast as possible, for in its present form the party was consuming 230 lb. of food a day and each extra day which was occupied in crossing the range meant that we would have a week less for our work in the country beyond. Moreover the cost of employing such a large number of men was considerable.

Having made a late start on the 26th it took us three marches to reach Paiju, below the snout of the Baltoro glacier. Being on a path the men went well, and except for the fording of the stream coming down from the Panmah glacier we had no trouble. But the weather was bad and we had a great deal of rain, which, besides threatening to spoil our all-important flour supply, which we could not protect while on the march, was depositing an alarming amount of snow on the range we were about to cross. Spender and Auden caught us up at Paiju, having completed their job on the Biafo glacier. Here our troubles began. On reaching Paiju, Tilman and Sen Tensing went down with a fairly severe fever; we could make no accurate diagnosis of their complaint and it was difficult to know what action to take. Auden volunteered to stay with them, and to deal with any situation that might arise, and it was decided that Spender and I should go ahead with the rest of the party and attempt to get them across the range. We had no idea how far the Baltis would be prepared to go nor what conditions we were likely to find. If they were to desert us early we would be obliged to relay all the stuff over ourselves, which, even if it were possible, would take several weeks of hard work. In any case the party we left behind would have ample time to catch us up, unless the fevers proved to be serious. It was agreed that, if we had no news of them by the time we had got all our food and equipment across the range, I should return to decide what was to be done, leaving Spender to begin his preliminary work on the Sarpo Laggo glacier.

Only one route across the main watershed between the Shimshal and the Karakoram passes, the western and eastern extremities of the range, had been used by Europeans. This was the Muztagh pass which had been crossed by Sir Francis Younghusband in 1887 at the end of his trans-Asiatic journey, and which subsequently had been used only once, by the party sent into the Shaksgam by the expedition led by H.R.H. the Duke of Spoleto in 1929. This pass is known to have been used prior to Sir Francis' journey by Baltis, emigrating into, and trading with, Chinese Turkistan. But it had long fallen into disuse, and an alternative pass was said to exist somewhere in the vicinity of the head of the Panmah glacier, though its exact position is not really known. Both the 1887 and the 1929 parties had encountered

considerable difficulties and it was by no means certain that it would be possible in any year to get laden men over the Muztagh pass, particularly as early in the year as we were attempting the crossing. Professor Desio of the 1929 expedition however had reported the probable existence of an easier saddle at one of the heads of the Trango glacier, which is the second tributary on the true right flank of the Baltoro glacier. We decided after much deliberation to attempt the crossing by way of this saddle. The plan had one great drawback, in that the Baltis all regarded the Trango as entirely unexplored ground, and however much we expressed our confidence in the existence of a route, we could not persuade them that they were not being led to an impasse, and they had to be driven every step of the way.

On the first day after leaving Paiju, May 29, we got involved in badly broken ice in crossing the Uli Biaho glacier at its junction of the Baltoro, which did not improve the mental state of the coolies. On the 30th we had a very long and anxious day coaxing them over the desolate intricacies of the Trango glacier. It was an exasperating business, and our difficulties were increased by falling snow and a cold wind. Unfortunately we did not succeed in reaching a point from which we could reconnoitre the upper part of the glacier. That night we were introduced to the worst trait of the Baltis. When conditions are bad they seem to be entirely incapable of looking after themselves. They crumple up in the open, and refuse to do anything towards making themselves comfortable or protecting themselves from the wind. We were obliged to bully them into action in order to avoid deaths from exposure. The next day, after moving the party a short way farther up the glacier, Spender and I set out to look for the pass. We realized that the spirit of the coolies would only stand one high camp, and that, only if the weather improved. It was essential then to get the camp within striking distance of the watershed. But we returned at 4.30 thoroughly depressed after a long climb, having drawn a complete blank. The coolies noticed our depression and demanded that they should be paid off and sent home. Until dark there was terrific confusion, every one shouting at once, and no one listening to what was said. Occasionally blows were exchanged between the coolies themselves. The Sherpas struggled nobly to help us to deal with the crisis, but when darkness fell and cold put an end to the tornado of abuse, we had no idea whether or not the men would go any farther. Fortunately the morning of June 1 was brilliantly fine, and with promises of greatly increased bonuses the men were induced to start.

We got on to hard snow on the main glacier and made very rapid progress. We climbed a steep but easy ice-fall of a side glacier, and saw before us what we took for the proposed pass. It was separated from us by easy ground. We camped on a little plateau at about 17,000 feet, and spent a busy evening taking off the men's boots ourselves and placing them on rocks in the sun to dry, digging and levelling spaces on which they could sleep, issuing rations and fire wood (which we had brought up from the Baltoro), and helping the men to light their own fires. In this way they were persuaded to spend one more night with us. Though the night was fine, a bitterly cold wind blew which produced another crisis in the morning. We got going early however on beautifully firm snow. But higher up we found deep powder snow and though

Up the east Surukwat valley to the Aghil pass
Phot. J. B. A.

bass
. A.

Phot. H. W. T.

Conglomerate cliffs in the Zug Shaksgam valley

Phot. H. W. T.

Zug Shaksgam river just below the point reached by Major Mason in 1926

we went ahead with the Sherpas and stamped a trail, the Baltis became very exhausted. When we reached the saddle we found that we were not on the watershed, but that another col lay in front of us, about a mile and a half away across a hanging glacier terrace. This proved to be the last straw. However it was still early in the day and before the Baltis arrived on the saddle we descended on to the terrace and flogged our way half the distance across it. Here we spent one and a half hours shouting back to the Baltis that they had got to come to us in order to receive their pay. These threats eventually worked. Amongst our coolie force we had seventeen men who had been recruited in Skardu. These were greatly superior to the Askole men, and even now, after a little persuasion, expressed themselves willing to come on with us. The rest were paid off. We watched them on to safer ground and made a stack of their loads. Then, carrying as much as we could, we struggled up to the second saddle from which we looked down on to the Sarpo Laggo glacier. Snow conditions on the northern side were very bad indeed. We had to work as hard as we could to get down to a rock outcrop on which to camp before nightfall.

On June 3 another relay was brought over the pass and, early on the morning of the 4th, Auden arrived bringing the welcome news that Tilman and Sen Tensing were somewhat better, and were following slowly. We sent a Sherpa and two Baltis to help them, and I escorted the first relay down the glacier to Mone Brangsa. There we found the remains of Professor Desio's camp, and probably Younghusband's, and obtained scraps of fuel. We found that a side glacier just above this place had made an enormously rapid advance. In 1929 Desio had shown it as a tiny ice stream ending a long way above the floor of the main valley; now it is a considerable tributary joining the Sarpo Laggo glacier in a confusion of ice pinnacles. Desio's photographs of the place confirm the fact of this remarkable change.

Meanwhile Spender had begun his survey. From the upper part of the glacier K^2 was clearly visible. It was the only G.T.S. point which could be seen from anywhere in the district, and the whole survey, with the exception of the work in the Aghil range, had to be based on it. Using a Wild theodolite, subtense-bar and plane table, he laid out a base and fixed the relative positions of a large number of prominent peaks in the district, which formed a network of fixed points for a plane-table survey. This process was repeated at intervals throughout the season, in order to keep a check on the plane-table work, and to renew the supply of distant fixed points. Azimuth determinations fixed the map with relation to K^2. It had originally been intended to take with us a portable wireless set in order to be able to carry out longitude determinations, but the firm to whom the order for the set had been given had failed to deliver it, and so we were deprived of the opportunity of doing this valuable work. Spender made latitude observations from time to time.

We returned to the upper camp on the 6th, and the following day went over the pass to fetch the last lot of loads from the dump on the glacier terrace. When we reached the top of the pass we saw Tilman and his porters coming up from the other side. Tilman's fever had come on again during the previous night and he was having very great difficulty in getting along. Sen Tensing had recovered but was still rather weak. Auden and I took a round of angles

from a point above the pass before returning with the others. It was a great relief at last to have the whole party and all the stuff on the right side of the range. By June 10 we had relayed all the loads down to Mone Brangsa. Leaving a big dump here we took to a camp some 3 miles below the snout of the Sarpo Laggo glacier sufficient food for our proposed expedition to the Aghil range. Here, on the 15th, we had a day's halt, which Spender occupied in mapping and in determining the distances to and heights of peaks in the neighbourhood. Auden was occupied with geological work, while Tilman and I shot a couple of bharal. We also discharged all but four of the Skardu men, for although we had hoped to take them at least as far as the Shaksgam, they refused to come any farther. I sent Angtharkay and Lhakpa to accompany them some of the way back, while the rest of the party started working the loads up the Shaksgam. We wasted a good deal of time in doing this, but it gave Spender and Auden an opportunity of doing their work. Also Tilman's fever had come on again. But when the two Sherpas caught us up we were able to shift all the loads, which included three weeks' supply of food, without the tedious business of relaying.

Our difficulty now was to decide upon which of the many valleys coming down to the Shaksgam from the Aghil mountains was the one by which Sir Francis had descended from the Aghil pass. The largest and most obvious valley, which cut right back into the range and which Desio had taken for the valley leading to the pass, did not answer in any particular to the one described by Sir Francis. Eventually, after fording the river, we selected a steep and inconspicuous nala which we thought was most likely to be the right one. We were correct in our choice and as we made our way up it we found plenty of evidence of the caravan route over the pass. Some of these traces appeared to be very recent, though for what purpose the route could now be used it is difficult to say. We crossed the Aghil pass on June 20 and camped by a fine lake half a mile below it on the northern side, among drifts of mauve primulas which covered the grass slopes above the shore.

The next day Auden left us to carry out a geological traverse to the Yarkand river, and to explore the possibilities of an alternative pass over the range to the west. Tilman and I climbed a 20,000-foot peak to the east of the pass in order to see into the country between it and the ranges explored by Professor Mason. The weather was perfect. From the top we obtained uninterrupted views in every direction. We concluded that to the east we were looking into valleys running into the Zug Shaksgam. We secured a complete photographic panorama. Meanwhile Spender was busy preparing the framework for his survey of this portion of the range. From the pass several G.T.S. points of the Karakoram could be seen. Besides K^2 there were the Gasherbrum peaks, also "Broad Peak" and "Staircase."[1] These provided good checks for Spender's range-finding and azimuth methods, and I think it can be claimed that the position of the Aghil pass was fixed with sufficient accuracy. Observations for latitude provided an additional check.

On June 22, leaving Spender to continue his work in the vicinity of the pass, Tilman and I, with two Sherpas and two Baltis, descended to the north,

[1] The officially recognized name for Conway's "Staircase Peak" is now *Skyang Kangri*. The name "Broad Peak" has been authorised.

taking with us twelve days' food. A tremendous amount of yak dung lying around the lake had provided us with fuel, and was evidence that the pastures hereabouts are at present used extensively, probably by Turki nomads. A couple of miles below our camp we came upon a much-used shepherd camping ground. We went on down past the junction of several big valleys coming in from the west and camped at the foot of the first big eastern tributary of the Surukwat. We called this the Kharkhul Lungpa.

The following day we made our way up this valley. Our object was to find a way over into the large valley which we had seen from the top of the peaks we had climbed, and which we suspected would prove to be the lower part of the Zug Shaksgam. After going for two hours Tilman was again taken ill with fever. He stayed behind with one porter while I went on with the rest to explore the head of the valley. Farther up, it divided into two branches. I chose the left-hand one and we carried all the loads to a col (about 18,000 feet) at its head. I found that it led over to another tributary of the Surukwat. However, it commanded a fine view to the north, and I took a round of angles with the Watts theodolite. We managed to get back to the main Kharkhul Lungpa by nine o'clock, when it got too dark to travel. The next day, leaving the rest of the party here, Angtharkay and I explored the glacier of the right-hand branch. Higher up the snow was very bad, but we reached a saddle (about 19,500 feet) at one of the eastern heads of the glacier. It provided a practicable pass into the country we were trying to reach. When we got back to camp we found that Tilman and his porter had come up. This bout of fever had only lasted a day and proved to be the last of the series.

The next day we carried all the loads to the top of the pass, took a round of angles and photographs with the photo-theodolite and descended the glacier on the other side; we managed to cover some 4 miles of it before dark. Until the results of our various surveys have been worked out it is difficult to give an accurate description of the topographical details of the range we were going through, as we were in entirely unexplored country, and had no means of fixing in the field our own position, or that of anything we saw. I hope we have brought back sufficient data to be able to plot our traverses and photographs. We found ourselves in a large glacier system with numberless branches coming down from the extraordinarily complex range we had just crossed, whose general trend seemed to us to be from north to south.

After leaving the glacier we entered a difficult conglomerate gorge. As we had made a very early start we found the stream to be fordable and were able to follow its bed without being forced up on to the almost unclimbable flanks of the nala. We were obliged to cross the river about twelve times, and had to go as hard as we could to reach its end before the late afternoon floods. Even so we had to camp half a mile above its junction with a large valley running south-east to north-west. There was a plentiful supply of birch wood and other fuel. When we reached this valley early next morning we found that it contained a very large river—certainly bigger than the Shaksgam at the place where we had crossed. We concluded that this must be Mason's Zug Shaksgam. We decided to follow it upstream for a day or so and then to make our way down it. On a well-wooded spit of land at the junction of the two valleys we were surprised to find a collection of stone

shelters. As there was no possibility of grazing in the vicinity, this spot must have been used as a regular halting place on some route. But from where and to where we could not guess. Below this point the river entered what appeared to be an almost impassable gorge. Angtharkay was sent with one Balti to see if it were possible to force a way through this, while the rest of us were exploring up the river. Each party took food for one night. The weather being fine we were able to dispense with tents and carrying very little equipment were able to travel at a great speed.

Along the floor of the valley, or on the ancient river terraces which are such a prominent feature of this country, the going was good, though we were held up from time to time by deep ravines cut into the conglomerates by side streams, and sometimes by the side streams themselves. We came upon several oases caused by springs of water. At each of these we found buildings of various types; at one was a collection of interesting dome-shaped huts. It seemed as though a little simple irrigation of these terraces would render the valley very fertile, but we did not see any traces of cultivation, recent or ancient. The problem presented by these relics of former habitation in such difficult country is a very interesting one and should be more closely investigated. By nightfall we had covered a lot of ground and fancied that we must be approaching the farthest point reached by Mason from the opposite direction. The valley had opened out enormously and we could see a lot of the surrounding country. We started again at 3.30 next morning, went several miles farther up the valley, crossed a large side nala which we fancied came down from the peaks above Durbin Jangal, and climbed a prominent spur standing some 2500 feet above the valley at the corner of a big bend in the river. We recognized several of Mason's points which now stood around us. After taking a round of angles and photographs with the Watts-Leica instrument we descended to the valley and marched up it to a point nearly opposite that which Mason had reached. The river appeared to be unfordable.

We failed to get back to our dump that day and spent a hungry night on the way back. When we reached it next day Angtharkay reported that he had failed to find a way through the gorge. He had found however that it was possible to circumvent the gorge by climbing some 4000 feet up the steep side of the valley. Two days later we got down into a valley which flowed back into the Zug Shaksgam 4 miles lower down. We did two high photo-theodolite stations on the way. We reached this side stream at about three o'clock in the afternoon, and, badly misjudging its volume and steepness, attempted to cross it. Tilman was swept off his feet but managed to climb out on the other side. He and I held a rope across the water and Lobsang and Angtharkay started across. A rolling boulder upset the latter, and although Lobsang made tremendous efforts to hold on to him, Angtharkay was carried away down the river, his waterlogged load making it impossible for him to struggle effectively. It was a sickening sight, and we could do nothing to help, for had we let go of the rope Lobsang would have gone too. Angtharkay was being crashed against the rocks with tremendous force and I expected any moment to see his head go under for good. However before this happened, by a stroke of luck, he got hung up on a rock in mid-stream, and Lobsang being safely across, the Baltis were able to drag him ashore. He was badly shaken, and

so bruised that for once he was unable to laugh at his own misfortune. But fortunately no bones were broken, and wrapped in dry sleeping-bags he recovered quickly. We had to remain where we were. It rained and snowed heavily throughout the night, and Tilman and Lobsang on the other side of the river, without any covering, fared badly. By dawn when we started, the stream was reduced to ridiculously small dimensions and we were able to make our way down the valley by continually fording it. But it was an alarming business for the rain and snow had soaked into the conglomerate cliffs which towered thousands of feet above us. Stones and boulders kept up a continuous bombardment all the way down the valley, and we had repeatedly to take cover.

When we regained the Zug Shaksgam at 9 o'clock we found that we were just below the mouth of the gorge down which Angtharkay had failed to find a route. We hurried down along the wide gravel flats as fast as we could, for our food was running short and we were by no means sure how long it would take to get back to the Surukwat, though by now we were certain that it was to there that the Zug Shaksgam flowed. After a mile the river swept against the cliffs on our side of the valley, rendering further progress along the river-bed impossible. Again we were obliged to climb 4000 feet up steep mud cliffs and traverse along above the valley. Going was difficult and complicated. We were continually being forced to perform some hair-raising feat of rock climbing on vertical conglomerate cliffs. The Baltis excelled at this as they did in dealing with dangerous rivers. Lack of water forced us to go on until long after dark, and we succeeded in regaining the river bed near an extensive *Jangal* a mile above the junction of the Zug Shaksgam and the Surukwat. On July 2 we marched up the Surukwat and found Spender's party encamped at the foot of the Kharkhul Lungpa. They had made full use of the fine weather, and Spender had mapped an area of about 300 square miles between the Aghil pass and the Yarkand river. We returned to the pass next day and found a note sent up by Auden with the unwelcome news that the Shaksgam was in flood. He also gave a rough account of his movements since he had left us.

He had descended the Surukwat, reaching the Yarkand river on June 23; here he met two Yarkandi boys, tending a flock of goats—these were the only human beings outside our party which any of us met during the active part of the expedition. Auden's party returned to a camp at 14,000 feet up the Surukwat on the 24th. It was here that Younghusband's guides in 1887 were in doubt as to which valley to follow. Auden ascended a minor peak of 18,300 feet for geological mapping and in order to prospect for an alternative route across the range. He succeeded in effecting the crossing by way of a pass about 18,600 feet in height, and so brought his party back to the Shaksgam by way of a long wide valley which proved to be the one which Professor Desio had supposed to lead to the Aghil pass. Auden named this valley the "Skam Lungpa" because of its barren nature. He had made a compass survey of all the country he had traversed, and examined its geology as far as was possible. He then ascended the Shaksgam to a point 3 miles above Durbin Jangal, where he found fossiliferous rocks of Permo-Carboniferous age. When the food supply was exhausted he brought his party back to the

base in the Sarpo Laggo, and while his two men were bringing more food down from Mone Brangsa he continued his geological work in that part. Fortunately the bad weather beginning on June 30 had reduced the size of the Shaksgam, and neither party had great trouble in crossing; but to have protracted our stay in the Aghil range even for a few days would have been very dangerous, though there was much we would like to have done. Before leaving the Aghil pass I managed to add to our food supply by shooting five bharal. This enabled us to spend a little longer in this part of the Shaksgam. While Spender was extending his map in this direction Tilman and I went some way up the main valley to try to recognize some of the peaks which we had seen to the south-west of the point we had reached in the Zug Shaksgam. We rejoined Auden at Sughet Jangal on July 8 just as he was about to set out in search of us.

The next day Tilman, Auden and I started up the K^2 glacier with two Sherpas, while Spender returned up the Sarpo Laggo glacier with the rest of the party. During the next week while all the food was being brought down from Mone Brangsa, Spender mapped the glaciers from the main range between K^2 and the Sarpo Laggo pass, and we explored the country to the north of K^2. We made a series of photo-theodolite stations, and there should be no difficulty in filling in that portion of the map. Tilman and I climbed an isolated peak of about 20,700 feet which commanded some of the finest mountain views I have seen. To the south of us were the colossal northern faces of K^2 and other peaks of the main watershed, the entire Aghil range from the Karakoram pass to the Oprang river and the peaks beyond the Yarkand river were to be seen, and we could trace the course of the Shaksgam valley from its source to its junction with the Yarkand. The fantastic spires surrounding the Panmah glacier were clearly visible, and we saw into the complicated tangle of great peaks at the head of the Crevasse glacier,[1] which was to occupy our attention for the next two months. Later we went up to the head of the main K^2 glacier and stood in a cirque formed by the Savoia Saddle, K^2, and Skyang Kangri ("Staircase"), and many unnamed peaks of equal grandeur. The north face of K^2 itself is stupendous, rising out of the glacier in one continuous sweep for 12,000 feet. We were able to sit beneath it and watch ice avalanches break off 2 miles above our heads and drift away, ground into wind-blown powder long before they reached the foot of the mountain. Tilman crossed from the K^2 glacier on to a large glacier which we had seen from our peak, flowing down from the north face of Skyang Kangri along the southern side of the dolomite walls of the Shaksgam. Auden unfortunately was now suffering from a fever displaying similar symptoms to the one which had attacked Tilman, and I contracted an attack of snow-blindness by foolishly stalking bharal for a whole day over a hillside covered with new snow, without wearing snow-glasses.

[1] The name "Crevasse glacier," which at first sight seemed a curious description for a major glacier of the Karakoram, was, after some discussion, adopted by the expedition and incorporated in the map because of Younghusband's definite pronouncement: "The glacier we did our best to surmount I called the Crevasse Glacier, on account of the great number and size of the crevasses, which were wider and deeper and far more frequent than I have seen on any other glacier." (*Geogr. J.* 14 (1892) 216.)

On July 17 the whole party re-united at the junction of the Sarpo Laggo and the Crevasse glacier valleys. A stocktaking of our food supplies showed that we had sufficient for fifty-five days. On the following day we started relaying everything up the Crevasse glacier. It was a slow business at first, but if we wished to be in a position to carry out any effective survey and exploratory work from the head of the glacier, we were obliged to take with us all the supplies we had. The exploration of country, when it is necessary to work from a base which is entirely out of reach of any outside assistance, presents a very different problem from that which one is used to tackling when some sort of transport and supplies, however bad, are available. This year I found, as I had expected, that cutting ourselves off from such support for a period of three and a half months placed a considerable strain on the party.

While we were working our way slowly up the glacier, Auden, with two Baltis, went down the Shaksgam river with twelve days' food, in order to continue his geological investigations in that direction. He also took with him the Watts theodolite. Our slow progress up the glacier gave Spender plenty of time for a detailed survey of the surrounding country. Two camps took us to the junction of a number of large ice streams flowing from all directions in an amazing confusion of pinnacles and ice-falls. We called this point "First Divide." Above it we got on to dry and broken ice, and going was considerably easier. We kept to our westerly course and by August 1 had established a camp about 17 miles up the glacier. Above this it divided into two branches of about equal size ("Second Divide"). Auden caught us up here, and in three parties, with light camps, we explored the heads of these branches. Auden and Tilman were prospecting for a route which would connect up the Crevasse glacier with the Nobande Sobande and the Biafo country; Angtharkay and I were trying to find a way over on to the head of Colonel Schomberg's Braldu glacier, while Spender investigated the head of the northern of the two branches.

On August 3, while Tilman and Auden were investigating another part of the watershed, Angtharkay and I reached a saddle at the head of the southern branch. The weather was bad, and in order to see anything we were obliged to climb down a difficult ice-slope on the other side for several hours. When we got below the clouds it was evident that we were in the upper basin of the Braldu, the whole of which could now be seen quite clearly. Having got down on to one of the branch glaciers of the basin, and thus proved that the pass was practicable, we returned by the way we had come. We failed to get back to our camp before dark, with the result that I had a serious fall into a crevasse.

The following day Tilman and Auden discovered a route over the main range to the Nobande Sobande glacier, and we returned to the Second Divide on the 5th. From here the other two took a camp up a large glacier coming from the north and called by us the "Crown glacier." We hoped that exploration in this direction would tell us something about the complicated range of mountains lying between us and the Shaksgam, and also connect up with Auden's surveys in that valley. I went up the northern branch of the Crevasse glacier to establish contact with Spender's party.

I found that he had already completed the survey of the northern branch and had also discovered an easy pass leading from its head towards the north-west.

The whole party reassembled at the head of the Second Divide and we were confined to our tents for two days by a heavy snowfall. As a result of our exploration of the head of the Crevasse glacier, and in view of the immense amount of work that there was to be done, it was decided that now the expedition should be split into three self-contained parties: (i) Auden, with the four

Sketch-map showing the heads of the Biafo and Braldu glaciers

Baltis, was to cross the pass they had found and descend to the Panmah glacier and so reach Askole. This party was allotted twelve days' food and the Watts-Leica instrument. (ii) Tilman, with two Sherpas, was to accompany Auden over his pass, and from the Nobande Sobande force a route to the so-called "Snow Lake," which forms the unknown head of the Biafo glacier, and having explored that to work a way across the ranges south-west of the Hispar pass. They were to take food sufficient for twenty-two days. (iii) Spender and I, with five Sherpas and thirty days' food, were to cross the pass which Spender had found and which we expected would take us into a

K² and K² glacier
Phot. J. B. A.

Phot. M. A. S.

Up the Sarpo Laggo glacier towards the pass from the Trango glacier

Phot. J. B. A.

Snout of Crevasse glacier from above the expedition dump

tributary valley of the Braldu, which we proposed to explore and map, and then make our way down to the Shimshal pass mapping as much country between that and the lower Shaksgam as weather and our food supply would permit.

Auden and Tilman crossed their pass on August 11–12. From the Nobande Sobande they succeeded in reaching a point on the divide between that glacier and the Braldu. They also climbed a 19,000-foot peak on that divide, on the top of which they did a theodolite station and took a round of photographs. Auden then made his way slowly down the Nobande Sobande and Panmah glaciers surveying and doing his geological work as he went. He became involved in very difficult country and had his work cut out to reach Askole in less than a day after his food had run out.

Tilman's party having made a dump on the first pass (which he called "Faith") in a blizzard, crossed it on August 15, and that evening camped on the eastern arm of the Braldu glacier. From the peak above this pass Tilman and Auden had enjoyed an extensive view which included Conway's "Ogre" (23,900 feet), the triangulated peak whose position relative to the Biafo was very puzzling, Kanjut peak (25,460 feet), the Upper Braldu, and the Drenmang, Chiring, Upper Panmah and Nobande Sobande glaciers, together with a mass of peaks to the south amongst which Masherbrum was very prominent. From here Tilman could make out a route to the west across the two main arms of the Braldu. If there was a pass at the head of the western arm it must lead either to the Virjerab or the Biafo; and believing it led to the latter he determined to attempt to cross it.

The next day was devoted to reconnoitring. Crossing a small saddle (subsequently called "Hope") into the western branch of the Braldu, they trudged up a long tributary glacier to the west. The saddle at the head of this was very rounded and they had to descend some way on the other side of it before being able to see anything. Clouds were rolling up from the west, but they were in time to see and recognize the strikingly bold peaks of the west wall of the Biafo, and the end of what the Workmans had called the "B.15 Range," which we had come to know so well from their photographs.

Two days later they camped on the north side of the so-called Snow Lake, the upper basin of the Biafo glacier. Tilman estimated its area to be about 30 square miles. It is remarkably flat and perhaps that might be sufficient justification for the name. A day was devoted to examining the south side and the two feeder glaciers which led east in the direction of the Nobande Sobande and Choktoi glaciers. The southern boundary of the Snow Lake is the high precipitous and remarkably straight ridge, on which, at the eastern end, stands the Ogre. The ridge terminates some 10 miles west where the Biafo proper descends in a south-easterly direction. On August 20 they traversed the Snow Lake, which at this season was mostly bare ice, and camped under the west wall of the Biafo just below where the wall turns west towards the Hispar pass. On the other side of this wall lay the Cornice glacier, which the Workmans said was without an outlet. In three days' time they found and crossed a pass over the west Biafo wall on to it. The basin of this glacier is low-lying, perhaps not more than 15,000 feet, shut in between high steep walls as the Workmans had described it, and

remarkable for the luxuriant vegetation growing in its valley within a mile or two of the head. Some 5 miles west from the Biafo it is joined by a slightly larger glacier coming down from the Hispar wall. It was disappointing to find the glacier behaving in a perfectly normal manner, and some 2 miles below the junction the combined glaciers terminated in a small grazing village in the Kushuchung valley. They emerged into the main Basha valley at the village of Bisil just below Arandu. Wishing to make quite sure that this was indeed the Workmans' Cornice glacier, they crossed, after some vicissitudes, a pass over the Ganchen range which bounds the Basha valley on the east, and thus reached the Hoh Lungma and Sosbon glaciers. Following up the Sosbon in the footsteps of the Workmans they climbed the col at the head and looked down, as the Workmans had done, upon the Cornice glacier and the pass which they had crossed from the Biafo ten days earlier.

Tilman's journey was a fine performance. In the space of three weeks allotted to him he covered a tremendous amount of ground. He managed to connect up the country which we had been exploring and the unexplored head of the Biafo with the country round the Hispar pass, and also succeeded in unravelling the complicated glacier system to the south-west. In doing this he solved two interesting geographical problems, the nature of the Snow Lake, and the supposed phenomenon of the Cornice glacier.

Spender and I spent a few days in completing the survey of the southern section of the Crevasse glacier. The section of country from which it rises is topographically one of the most interesting of the whole Karakoram range, for, besides the Crevasse glacier itself, it gives rise to a series of gigantic ice-streams such as the Hispar, Biafo, Panmah, Virjerab and Braldu. These glaciers, flowing in different directions, terminate at points which by the only known routes are many weeks' journey from each other. Only one pass had hitherto connected up any two of these glaciers (the Hispar pass, between the Hispar and Biafo glaciers, which was crossed by the Conway and the Workman parties in 1891 and 1903 respectively). It was fascinating now to be in a position to make a thorough exploration of this area and to be able to cross passes from one glacier to another almost at will. The scenery too was superb and enormously varied, the limestone mountains to the north being in striking contrast to the granite peaks of the southern glaciers. Strewn over all the glaciers which we visited we found large numbers of dead birds of many kinds, mostly belonging to the duck family, though there were also some much larger skeletons, bones of which I brought home for identification. Presumably all these birds had perished during migratory flights, though it is hard to understand why they should choose such difficult routes from Central Asia to India.

We started up the northern branch on August 13, and on the 17th managed to get all our loads over the saddle which Spender had found. We descended to a very badly crevassed glacier. The crevasses were disguised by a covering of fresh snow and as we were all carrying enormous loads (the Sherpas were carrying more than 130 lb. each) we had some difficulty in getting through. The next day we climbed a peak in order to get some idea of the country we were now in, and Spender set up his plane-table on top. The country to the north was very complicated and there was still no evidence that the

mountains in front of us formed the southern walls of the Shaksgam. The glacier we had descended plunged down in a 1000 foot ice-fall below the point at which we had camped, to join another larger glacier (which later we named the "Wesm glacier") flowing in a north-westerly direction. From our peak we had a good view of the head of this glacier which, we imagined, shared a common watershed with the Crown glacier.

But in order to get any idea of country which was still a closed book to us, we saw that we must go up to a high point on the watershed. Spender had fixed from his earlier stations several peaks in this area which were now of very great value to us. The same day we descended the ice-fall to the Wesm glacier and took a light camp up it to a point on its right bank at about 16,000 feet. From here the view down the valley puzzled us a lot. Instead of the glacier flowing gently down into the Braldu as we had expected, it ran steeply through the usual pinnacled zone, and ended abruptly 5 miles down. At first we thought that the valley below made a right-angled bend to the north, but soon we saw that it kept on its north-west bearing, and we began to suspect that it would turn out to be the nala which Colonel Schomberg had noticed joining the Braldu valley, near the snout of the main glacier and called by him "Wesm-i-Dur." This suspicion proved to be correct. On the 19th we climbed to a point, over 20,000 feet high, on the ridge bounding the Wesm glacier on the north. A large cornice on the narrow ridge made it a difficult station on which to work, but it commanded a superb view. We were able to disentangle much of the country towards the Shaksgam and also had a view down the Crown glacier. Many of the peaks we had been amongst a month earlier, including K^2, were visible, and provided a welcome check on the accuracy of the plot of our present position. To the west the great peaks of the Kanjut range provided us with new food for discussion and argument as well as a renewed vision of the incredible size and majesty of the Karakoram. North-west of us were the snow domes of the Shimshal mountains, beyond which in the blue distance stretched range after range towards Kashgar and the Hindu Kush. We were lucky enough to have another perfect day and were able to spend many hours in trying to digest this limitless tangle of country. We camped that night amongst the ice-pinnacles a few miles down the glacier and the following day reached a grassy plot by the stream of the Wesm-i-Dur, which provided a welcome change after more than a month of glacier camps.

On the 21st while Spender was plane-tabling and the rest of the loads were being brought down from the glacier, Angtharkay and I went after fresh meat. Through my own fault I failed to shoot a bharal, but managed to get some *ram chikor* (snow cock) instead. We saw a tremendous number of these birds throughout our stay on the northern side of the main watershed and had found several nests earlier in the year. It was rather a difficult job to shoot them with a rifle; a small shot-gun would have paid well for its transport, for there is a great deal of meat on these birds. Although we had come across any number of *kyang* (wild ass) in the Aghil range and in the Sarpo Laggo, we saw no trace of them in the valleys of the Braldu basin. Hares were plentiful in all the valleys below the glaciers. On the Crevasse glacier the Sherpas had caught a fox.

The ancient river terraces, extending several thousand feet above the present river level and cut by side streams into fantastic canyons, caused us a great deal of trouble, as they had done in the valleys of the Aghil. Although we gradually evolved a technique for dealing with the obstacles presented by these conglomerate deposits, it was always a somewhat frightening business negotiating them with a heavily laden party, and it took us three days of bad weather to unravel the intricacies of the Wesm-i-Dur, and to reach the wide gravel flats below the Braldu glacier, where we found a sheep pen and a shepherd's hut.

On August 26 we started up the Braldu glacier taking with us food for eight days. The first night we camped on beautiful pastures 5½ miles up the glacier. While stalking bharal above these, Angtharkay and I came across a pack of six wild dogs which were after the same herd as we were. In the confusion which resulted the bharal escaped unharmed. The next day we made another 5½ miles, and on the 28th we camped in the midst of the vast glacier basin into which Angtharkay and I had descended on August 3. The next four days were perfect and we wasted none of our precious time. Angtharkay, Lhakpa and I reached a high saddle at the head of a branch glacier on the west. It was not situated on the main watershed as I had hoped, but from it we were able to climb a small peak (about 19,000 feet) for a round of photographs and compass bearings. Again I was able to see the great peaks of the K² range, and this time my view was extended past the Muztagh Tower to Masherbrum and the pinnacles of the lower Baltoro whose acquaintance we had made three months previously. Conway's Ogre and all its fantastic satellites were now close at hand, and seen from this angle they looked more astonishing than ever. But all this was of small interest compared with the fascinating newness of the world we were in.

While surveying on a glacier to the south, Spender saw through his telescopic alidade a large cairn. We sent two Sherpas to investigate this and found that it had been built by Tilman's party to mark the site of one of his camps. There was a letter in it, telling us of his movements up till August 18 and of his discovery of a route to the Biafo.

The Braldu glacier proved to be a very large one with a great number of branches in its upper part. The head of some of these branches were 22 miles from the snout of the main glacier. The basin of the Braldu glacier abuts on those of the Virjerab, Biafo, Nobande Sobande and Crevasse glaciers, and its bounding walls form a considerable part of the main Asiatic watershed. With the help of his survey of the head of the Crevasse glacier, and the fine weather, Spender had no difficulty in completing a detailed survey of this basin in the short time allotted to him for the task; and we got back to our dump at the beginning of September with the job finished. The still much swollen Braldu river gave us a lot of trouble before we reached a deserted village at the foot of the valley coming down from the Shimshal pass. We had now developed a good technique for crossing swift rivers: one man was tied on to the end of the rope and the rest of the party would anchor the rope at a point upstream, preferably on the outside of a bend. Leaning, if necessary, his full weight on the rope, the first man would then advance through the water, swinging pendulum-wise on the rope. The rest of the party (except for the

Phot. M. A. S.

The Skamri peaks from the upper Crevasse glacier

Peak 18/43 M from the Snow Lake Phot. H. W. T.

Skaunri peaks seen from the south-east across the Drenmang glacier
Phot. J. B. A.

last man), carrying the bulk of the loads, would have the safeguard of a rope stretched at right-angles across the river as well as the pendulum rope, and the last man would cross in the same way as the first. The support of the pendulum rope enables one to withstand the force of the water to an astonishing extent.

The deserted village (Chikar) was surrounded by a beautiful grove of willows. The day after our arrival there, shortly after we had got down from a morning's work on the hills above, four men and four yaks came from across the river. The men proved to be Shimshalis. At first they were very scared of us, but although we had no language in common we soon convinced them of our friendliness. We managed to converse with them by means of signs, and soon learnt a small vocabulary of their words. We managed to persuade them to send one of their party over the Shimshal pass to get us some food. This man took with him the news that some Chinese had come across the Muztagh river—he had evidently taken our pig-tailed Sherpas for the leaders of our party. This startling report was carried to Hunza and thence to Gilgit.

We spent a most interesting week in the lower Braldu valley escorted by our Shimshal friends who were quite delightful. At frequent intervals down the valley we found well-watered oases which are used by the Shimshalis as winter grazing grounds. The Yarkandis, we were told, do not penetrate as far as here. A great variety of birds inhabited these lush oases, the commonest of which was the hoopoe. Half-way down to the Shaksgam is an ancient fortress known as Darband. It is built on the edge of a conglomerate ravine at a point where the main stream flows through a narrow canyon, and must have rendered the valley quite impregnable from the north. The ramparts are still kept in good repair and our guides were very particular about keeping barred the great wooden gate through which we were allowed access to the lower valley. The towers of the fortress are still used, and in one of them we found some ancient matchlock guns and drying bharal meat and skins, together with some ripening cheeses. Looking down from the turrets over the battlements and across the grim gorge in front, one had an impressive sense of the present mediaeval state of Central Asia.

While Spender was doing some high plane-table stations above the valley I rode with one of the Shimshalis down to the Shaksgam. On the way in a wood of tall willows I was shown one of the places from which salt is extracted from the soil. A pit is dug and flooded with water which is then churned up with the soil containing the salt. The mud is allowed to settle and the water is evaporated from the salt solution in slate and clay vessels. It is a long and tedious process and the output of salt is very small. This and the enormous distances to which it is carried are evidence of the value of this commodity in these parts. From the junction of the Braldu with the Shaksgam, a scene of magnificent desolation, I went some way up the great gorge of the Shaksgam and climbed a long way up its cliffs to get a view of this part of the Aghil range. The river contained an enormous amount of water, and though the cliffs of the gorge could probably be forced by a mountaineering party, it can only offer a practicable caravan route for a very few months in the winter.

We returned to Chikar and from there crossed the Shimshal pass to the grazing village of Shuijerab. The pass itself is situated in open, gently undulat-

glacier
Phot. J. B. A.

ing country and it was hard to believe that we were crossing the main continental watershed, so great was the contrast with the other sections of it which we had visited. Just below its crest on the eastern side was a large village of some four dozen houses which is only occupied in the winter. On the western side of the pass is a lake, a couple of square miles in area, below which enormous herds of yaks and sheep were grazing on the extensive pastures. From the top of the pass we had a grand view into the country which we had been exploring. It was a fine day and Spender was able to get a good fix for the position of the pass and to round off the survey of these parts. The country to the north-east of the pass is still quite unexplored and we were sorely tempted to penetrate it by way of one of the large glaciers flowing down from its dome-shaped peaks, and to look for a pass over into the Oprang river. But by now our boots were worn out and it was doubtful too whether we would be able to get the necessary food. We consoled ourselves with the reflection that, though there were thousands more square miles of this fascinating country to be explored, we must stop somewhere if we were to get back to England during the winter, which unfortunately was imperative for both of us.

And so we went down through amazing conglomerate gorges to Shimshal where we were given a wonderful reception, and where we came to like the people of that isolated country even more than when we had first met them. The journey back from there to Srinagar by way of Hunza and Gilgit was the most varied and the most absorbingly interesting which I have made through populated districts of the Himalaya.

Exploration and survey

The party surveyed about 500 square miles, and an accurate system of heights was carried throughout the whole area. In undertaking this work Spender was set a difficult task, for it was necessary to reduce his equipment to a minimum. In dealing with this difficulty and with the remarkable absence of fixed points on which to tie his work he displayed considerable ingenuity. Again, the necessary lack of tent space compelled him to do his compilations, the inking in of his sheets, and the difficult job of transferring from one plane-table sheet to another while lying in his sleeping-bag in a tent 6 feet by 4 feet which was often shared by a companion. The maintenance of his enthusiasm for the job and of his standard of accuracy throughout the expedition was responsible for the achievement of satisfactory results.

Perhaps the three main items of interest in the field of exploration were: (i) the fixing of the geographical position of the Aghil pass. (ii) The tracing of the course of the Zug Shaksgam river from the point reached by Mason in 1926 to its junction with the Surukwat and Yarkand rivers. (iii) The unravelling of the topographical problems at the sources of the great glaciers of the Panmah, Biafo, Virjerab, Crevasse, and Braldu.

The area explored included 75 miles of the main Asiatic watershed whose northern side was hitherto unknown.

Mountaineering

With such a vast area of unknown mountains to explore, the climbing of any of the countless peaks one sees offers little interest compared with the

enthralling business of finding one's way about the country, and crossing passes which lead from one region of mystery to another. Incidentally this occupation provides all the mountaineering one could wish for. In the course of our travels about half a dozen peaks were climbed, but all for the old-fashioned reason of wishing to see the view.

We discovered and crossed seven major passes, four of which led across the main Asiatic watershed, and also four minor passes such as that which led from the Surukwat to the Zug Shaksgam, and that which led from the head of the Biafo to the Cornice glacier.

I should like to conclude by suggesting to mountaineers who have the opportunity of visiting the Himalaya that it is not by climbing its great peaks that we can most enjoy this unique range. We have now the opportunity to see the Himalaya as de Saussure saw the Alps. When the country is known, we shall enjoy it by climbing its peaks; and, when all the peaks are climbed, we shall look for more difficult routes by which to climb them, in order to recapture the feel of adventure and to demonstrate our modern superiority.

APPENDIX I: MAP-MAKING

MICHAEL SPENDER

In this expedition all members of the party were surveyors; it is only for this reason that it was possible to map so large an area. It is very seldom that the leader of an expedition considers the map as the first object of the journey; when this happens most of the surveyor's usual difficulties vanish. It should be realized that this involved for Shipton and Tilman a definite sacrifice. These two, if they were to further the map, had to give up doing throughout the expedition that which they would most have liked to do—to travel faster and cross more passes. Auden, too, threw himself with zeal and enthusiasm into map-making. Although his own science kept him very busy, he learned how to use the Watts-Leica phototheodolite; his survey of the head of the Panmah glacier (the Nobande Sobande) was the first map ever to be plotted from the Society's Watts-Leica phototheodolite.

The special problems of this area were (i) the scarcity of fixed points; (ii) the necessity for restricting the weight of all survey gear to 100 lb. or less. The only way of meeting the first condition was to make some more points. To do this by triangulation would have been out of the question. The only possibility seemed to be to use the Base method described in the paper by Nörlund and Spender, "Some methods and procedure developed during recent expeditionary surveys in south-east Greenland" (*Geogr. J.* 86 (1935) 321). It would be necessary to have some astronomical azimuths in any case; and observations for latitude and longitude might provide additional scientific results.

It was decided therefore to use a Wild Universal theodolite for the star work and for the base observations. By direction of the Surveyor-General this was kindly lent by the Frontier Circle of the Survey of India. The tripod and subtense bar were already the property of the Society. The main work would be to fill in from these fixed points on to a plane-table. For this the Society agreed to purchase the Wild plane-table equipment. This comprised, apart from the table (53×43 cm.—a very convenient size), a slow-motion attachment to the theodolite tripod, a telescopic alidade, level, plumb-bob, box-compass, slide rule, extension arm for alidade, divided scale, dividers, and accommodation for pencils, pens, inks, etc. In fact it was a kind of travelling office, which,

contained in a robust, metal-shod box with shoulder straps, weighed 22 lb. The table was of soft wood and weighed 5 lb. I doubt whether much weight was saved by specifying soft instead of the usual hard wood; in any case a spare should be carried, for one is continually anxious lest the table should be broken in a minor slip or fall. The light tripods weigh 10 lb. each; the theodolite 15 lb. in its case; the subtense bar (Wild Precision Invar) weighs 14 lb.

The telescopic alidade is an essential part of the equipment if triangulation is to be done on the table. Without it it is practically impossible to pick up stations which have been already or which will be later occupied. It shows up moreover very promptly any inaccuracies in the points laid out by the base method. Vertical angles can be read from it to the nearest minute in the same setting as that to draw the ray. The Wild alidade has the 36× magnification of the telescope of the Universal theodolite; angles are read through an auxiliary telescope.

The remaining part of our instrumental equipment was the Watts-Leica phototheodolite, of which there is a description in the *Himalayan Journal* of 1937. This instrument was as convenient and useful in the Karakoram as it has already shown itself to be in the high Himalaya.

For the plane-table I used Correctostat, an aluminium foil lined paper which served exceedingly well for plane-tabling (cf. *Geogr. J.* 87 (1936) 286). A roll of this, surrounded by a cardboard cylinder, was packed in an ordinary canvas case for a collapsible tripod, allowing a large area of paper to be carried without inconvenience. For the survey camera and for our private cameras Selo Fine-Grain Panchromatic Film was used and found excellent for the severe conditions of the expedition.

Immediately after crossing the pass into the Sarpo Laggo we camped on an uncomfortable piece of frozen moraine above Changtok. But this was close to a good position for the first base. When the usual range-finding observations were made, rays to all the points of this series, as well as many more for detail mapping, were laid out on the plane-table sheet. Passing from one base-end to the other I started a small avalanche, which delayed arrival at the other end. Fortunately however the weather was very fine that day. When, at that time of the year (early June), there was any wind at all at 19,000 feet, it was so unbearably cold as to make work almost impossible. K^3 was visible from here, and in fact from almost the entire area: it stands out like a cathedral spire above the roofs of a provincial town.

Bases were placed later at the foot of the Sarpo Laggo, on the Aghil pass, at the northernmost station I visited in the Aghil, on the Crevasse glacier and its northern branch, in the Wesm-i-dur, at the foot of the Braldu and at Chikar. Astronomical observations for latitude and azimuth were made at the foot of the Sarpo Laggo (by our main dump) and on the Aghil pass. From above the Wesm valley we had a long-range resection from K^2, Kanjut No. 1, and Dastoghil to check azimuth.

Plane-tabling was done on the 1 : 100,000 scale, a scale very suitable to show mountain detail without being too fussy. Almost every point intersected was fixed in height. Angles could be taken very quickly from the alidade, and the slide-rule supplied by the makers much reduced the work of computation. Metric notation was used, since the subtense bar was a 2-m. standard, and with the 1 : 100,000 scale arithmetic is reduced to a minimum. The sheets were inked up with 100-m. contours.

I myself never used the photo-survey equipment. The idea was always that some one else should do the survey of an enclosed area with the photo instrument: Shipton's experience of recognizing peaks, observing to them, and

booking them was of course of very great value and saved me any anxiety lest the stations would be inadequately fixed. This is an ideal way of working and saves the enormous trouble of carrying two plane-table surveys through new country. Auden was already experienced in carrying out and booking a compass traverse, which was also a great asset. Finally Tilman's journey showed how much a few photographs and bearings can be made to produce if they can be referred to a good survey framework.

From a surveyor's point of view the weather was exceptionally good. On the whole practically no time was lost on account of weather. I should say that there was a deterioration during the first three weeks of August, but fortunately at that time the party was moving so slowly in triple-banked relay up the Crevasse glacier that I was able to get the stations I needed. The time lost in crossing moraine-covered glacier, or the absolute obstacles of pinnacled ice or swollen rivers, make the real difficulties of the region. Some vantage point to scramble to can generally be found for the least skilled climber in the worst country.

Our method of survey, to make a framework of known scale including K^2 and then to find its azimuth astronomically, was tested by closing in on the Peak 18/43M. The closure was excellent in plan and height: it also identified this disputed point 23,900 feet high, which has variously been called the Ogre, Kailasa, and B.15.[1]

That we have a map to show is nevertheless due to the Survey of India, who took over the costs of compilation at the Geodetic Branch Office, Dehra Dun. Compilation took place on a very large board, on which was pasted a graticule of our area on the scale of the survey. Photographs of my own plane-table sections and of all adjoining work were mounted on this board. Photostations were graphically resected on it, and sheets for plotting prepared by making blue-copies of the areas concerned. These, when plotted, were again photographed and copies pasted to the compilation. The records of many surveys had to be looked into, in particular of Captain Deasy's triangulation of the Yarkand river in 1879; of Conway's journey up the Hispar in 1892; of the various journeys of the Bullock Workmans; of various journeys of Mr. and Mrs. Visser; of Major Mason's Shaksgam Expedition of 1926; and of the Italian Expedition of 1929. Colonel Godwin-Austen's plane-table made on his remarkable journey of 1861 was a perpetual reminder of the high standards laid down by the Survey of India.

The connection with Muhammad Akram's work on Visser's 1935 expedition was perfect; with Afraz Gul Khan's on Mason's expedition fair and reasonably imperfect where disagreement existed; with the Italian work very good. Serious discrepancies only occurred at the join with Afraz Gul Khan's work on the Visser 1925 expedition; that is in the Shimshal district. Here a wholesale adjustment had to be made: it is supposed that the present placing of the Hispar and Biafo glaciers, and of the glaciers and mountains between the Hispar and Shimshal, is reasonably correct.

The plotting of the photo-surveys was done by laying out the principal direction of the photographs on to the drawing paper and constructing a photo-line perpendicular to it at the equivalent focal length of the enlargement from the station. The Leica pictures were found adequate in every way for this work; heights were rounded off to the nearest 50 m. and found very consistent. The actual drawing was done by native draughtsmen who soon became very quick workers. Much office time is saved by fixing the station with the theodolite and only using horizontal photographs.

[1] See "Karakoram Conference Report." (*Geogr. J.* 91 (1938) 134–35.)

Nevertheless travellers must always bear in mind that the completion of a survey takes about as long in the office as it has taken in the field; and that unless this office work can be done during a wintering or similar pause in the field work, provision must be made for it afterwards. Our sincerest thanks are due to the Survey of India for having made it possible to prepare our map.

APPENDIX II: PROVISIONS AND COST

ERIC SHIPTON

Food allowance per day per man

Pemmican	4 oz.
Rice, flour, and tsampa	10
Butter	2
Dried skimmed milk	2
Sugar	8
New army emergency ration	1
Oats	2
Cheese	3
	32

Vitamins A and D were taken in Crooke's Halibut Liver Oil.
Vitamin C was taken in Hoffmann La Roche a-scorbic acid tablets.
„ B was taken in dried yeast.

The above ration was supplemented from time to time with fresh meat. There was no illness which could be attributed to food or vitamin deficiency, and the party was free from septic cuts and other sores.

Summary of Cost of Expedition	£
Food	92
Equipment	118
Travelling (including 3 passages to India and back)	239
Extras (hotels, tips, telegrams, meals on train, etc.)	54
Sherpas (pay, food, and travelling)	156
General transport	181
	£840

The above represents the total cost for four Europeans. The party was in the field for exactly five months.

Cost of food supplied to local coolies comes under the heading of "General transport."

Below are the estimates which I drew up two months before leaving England:

	£
Food	90
Equipment	110
Travelling	225
Extras	80
Sherpas	150
General transport	200
	£855

APPENDIX III: GEOLOGICAL RESULTS

J. B. AUDEN

Until the material collected on this expedition has been examined in greater detail, it is possible only to give a brief account of the main geological features of the country. The Karakoram ranges and the region to the north were not entirely unexplored from a geological point of view before our visit. Hayden had been in the Pamirs in 1914, Mason had collected fossils from the Sa Lungpa in 1926, and De Terra had examined the Depsang in 1928. Desio carried out in 1929 a valuable geological reconnaissance over some of the region which we explored. The only results of Desio that were available to us when we left Srinagar had been published in the *Journal* for May 1930. His more detailed account, and his sketch-maps, given in 'La spedizione geografica Italiana al Karakoram (1929),' and published by Bertarelli in 1936, were not to be obtained in India. A geological account of my own previous traverse to Baltistan in 1933 was published in *Records, Geol. Surv. India*, LXIX, p. 124 (1935).

It should be pointed out that no detailed geological mapping was possible on account of the absence of topographical maps, but the data and rough plans obtained during our traverses will permit of a reasonable geological map being made when the topographical map is available.

The sequence of formations determined is as follows:

Sedimentary rocks

Aghil series:	marine Triassic and Jurassic.
Shaksgam series:	Permo-Carboniferous, mainly marine.
Sarpo Laggo series:	slates, phyllites, quartzites, greywackes, impure limestones, probably of lower Palaeozoic age. These rocks become highly altered towards the south.

Igneous rocks

Dolerite:	Mesozoic or younger in age.
Lamprophyre:	post Triassic and post granodiorite.
Granodiorite: } Gneissose granite: }	post Permo-Carboniferous in age.

The sedimentary rocks are disposed in a broad syncline, with an axis running N.W.–S.E. The youngest rocks, proved by their fossils to be largely Jurassic in age, occur in the form of a basin about 16 miles in length, which occupies the part of the Aghil range lying between the Shaksgam and west-Surukwat rivers. Another basin of Jurassic rocks, probably *en échelon* with that found this year, must occur along the Sa Lungpa, since Jurassic fossils were found in Mason's collections from that river.

Surrounding the Mesozoic rocks occur successively the Shaksgam and Sarpo Laggo series. Fossils collected this year from the former support the list of genera previously found by Desio. The Sarpo Laggo series is mainly pelitic, and has been found extensively up the Sarpo Laggo and Crevasse glaciers, and along the lower reaches of the Surukwat river as far as the Yarkand. It clearly crops out in the Kun Lun range.

There is no doubt from the work carried out this year, and previously by Hayden, De Terra, Mason and Desio, that a zone of marine Tethys sediments extends for many miles along the northern side of the Karakoram range. The northern boundary of the marine facies must have been along what is now the Kun Lun range.

The whole region has been invaded by granodiorites and gneissose granites, in which the Permo-Carboniferous rocks sometimes occur as long wedges, divorced from their former associations. Lamprophyres cut both the granitic rocks and the sedimentaries, being found intrusive in the Shaksgam series and the *Megalodon* limestones of the Aghil series. These rocks are uncommon in India, except amongst the coal-bearing formations of the Gondwana basins.

Of great interest are the varied degrees of metamorphism shown by the Sarpo Laggo and Shaksgam series. When the Biafo glacier was visited in 1933, Auden was inclined to regard the metamorphic rocks found there as belonging to the archaean Salkhala series, which occupies large areas of Kashmir. Work this year has shown however that gradations exist from these altered rocks to the less altered and unaltered rocks of the lower Sarpo Laggo and Shaksgam valleys, and it seems probable, as believed also by Desio, that many of the metamorphosed rocks of Baltistan are relatively young.

All of us were impressed by the recent decrease in thickness of the Sarpo Laggo and Crevasse glaciers near their snouts. That these glaciers are subject to periodic changes is suggested by historical records, since at different times they have been easy and difficult of access. The Nobande Sobande branch of the Panmah was inaccessible to Younghusband in 1887 beyond Skinmang. It was so smooth and uncrevassed in 1929 that Desio was able to ski up to its head. In 1937 it was again highly broken up. The snout of the Biafo glacier has shrunk considerably since 1933, but appeared to show no seasonal retreat between May and August 1937.

DISCUSSION

Before the paper the PRESIDENT (Professor HENRY BALFOUR) said: The lecture which we are going to listen to to-night is concerned with a surveying expedition in an area which is of very great importance to the Royal Geographical Society. As a result of this expedition it has been possible to fill in what was a very glaring hiatus in the map which the Society has drafted. That the expedition was a successful one you will learn very shortly, and as there is a good deal to be said on the subject I will not delay you, but will ask the leader of the expedition, Mr. Eric Shipton, to tell us about it.

Mr. Eric Shipton then read the paper printed above, and a discussion followed.

The PRESIDENT: Two other members of the expedition are present, the third being still in India, and I am sure we should like to hear from them. I will call upon Mr. Tilman to add some remarks.

Mr. H. W. TILMAN: Mr. Shipton's account was necessarily condensed, nor is there time now for explaining the reasons for my short independent cruise. Sufficient to say that it was devoted to clearing up the misconceptions of earlier and better travellers than myself—Sir Martin Conway and the Bullock Workmans. I can assure you that for me it was a bitter disappointment to find that Sir Martin Conway's Snow Lake hardly justified its title and that the Cornice glacier of the Workmans' was not without an outlet as they had imagined. Almost thirty years ago, from this same platform, Sir Martin Conway ridiculed the idea of a completely enclosed glacier on scientific grounds, and last summer, when the discussion began afresh, he was supported by Shipton and Spender in opposition to Auden and myself. When I started I had hopes of being able to vindicate the Workmans and so confound the scientific sceptics; but, as you have heard, the Cornice glacier behaved normally, and that startling topographical phenomenon, a glacier with no outlet, has gone the way of the lost continent of Atlantis.

Some of you perhaps are less interested in mountains than in the men who visit them, so I am going to let you into a secret. I was never quite at home on this trip, for there was a man to whom slide rules and trigonometry are as intelligible as Chinese, making one of a party who thought in angles, talked in tangents, and read log tables for amusement—all this, by the way, in the metric system, so that if any height or distance was under discussion, pencil and paper were necessary to reduce it to intelligible terms. Shipton, of whom I hoped better, was the chief offender, and proved to be a confirmed "theodoliter"—a word I have coined and patented to denote the worshippers of the theodolite. True, in a moment of forgetfulness we did climb two peaks, and very good fun they were too, thanks, in the one case, to leaving the theodolite behind, and in the other the rope.

Those of you who read *The Times* may have noticed that we came upon the tracks of the Abominable Snowman; indeed the past season was a very favourable one for snowmen, not only in the columns of *The Times* but in their more usual habitat, the Himalaya. Mr. Smythe saw tracks in Garhwal which were obviously bear tracks, and in the course of a column and a half and with the doubtful assistance of several eminent zoologists, succeeded in proving that they were bear tracks.

The tracks I saw were certainly not those of bear. They were roughly circular, about 8 inches across and 9 inches deep, and the remarkable thing was that they were all on the same axis and not "staggered" to right and left as in the case of other four-footed animals. The Sherpas of course said they were the tracks of the "Yeti" or Snowman, of which there are apparently two variations, the larger which eats yaks and a smaller existing exclusively on men. These were of the smaller kind, and when I pointed out to the Sherpas that no one had been in those parts for thirty years and that he must be devilish hungry, they were not so amused as I expected. I think the pundits of the Natural History Museum must either accept the Yeti or else find us a carnivorous one-legged bird weighing several hundredweight.

To return to our journey: it was all work of great interest carried out amidst the most remarkable mountain scenery—scenery that attracts by its grandeur and repels by its desolation. Moreover we were there for a definite purpose, supported to some extent by this Society, by the Royal Society, and by the Survey of India. I hope you will agree that much was accomplished. It was due to the fact that Shipton ran the show as he has run others: lightness, mobility, and simplicity were the keynotes. If you grasp that important point you will be able to understand how we covered so much ground and how we existed in that inhospitable country for four months without seeing a village and beyond reach of supplies.

The PRESIDENT: I will ask the other member of the party who is present, Mr. Auden, to address us.

Mr. J. B. AUDEN: This is not the occasion for going into details about the geology, but I might mention one problem that was interesting us. It is well known that the Himalayas and the Alps are young mountain chains, but it is also known that there were older revolutions or periods of earth movement that had taken place before the latest Tertiary movements, and one of the things that I was trying to find out was whether there were any signs of the older movements incorporated in the younger. I think it was Professor Gregory who used the analogy of a cathedral. You might have a Norman structure with a Gothic superstructure built upon it, or you might have a Norman building pulled down and its stones used again in making an entirely new building. In the Garhwal there are certain signs of the earlier structures, but it is quite

definite that most of the structures are Tertiary. On the other hand, in the Alai and Kun Lun mountains the structures are probably old and have to only a small extent been refashioned by the later earth movements. We found in the Karakoram that the fossiliferous rocks, of Permo-Carboniferous and Mesozoic age, were laid down upon a basement of older rocks without any marked unconformity, and that both series have been penetrated and altered by young granites. These mountains would appear to show few signs of the older earth movements and to belong in the main to the youngest revolution.

A word about the glaciers. At the end of his long traverse across Asia, Sir Francis Younghusband went up the Panmah glacier in the hopes of finding an alternative route over the Karakoram range. He was unable to get beyond Skinmang because the ice there was piled up in blocks as large as houses and the glacier beyond was completely inaccessible. In 1929, Professor Desio, the geologist of the Italian Expedition, was able to use skis over a considerable part of the glacier, and his photographs show that it was remarkably smooth. When Tilman and I came over from the Crevasse glacier we thought that the Nobande Sobande branch of the Panmah, in spite of its crevassed appearance, would be a moderately easy route for me down to Askole. This glacier turned out however to be so broken up by gaping crevasses and tumbled masses of ice that our route had to be made laboriously down the left wall of the valley. This is an interesting point, for it appears that this glacier must be subject to periodic changes, sometimes being relatively uncrevassed and smooth, at other times highly broken up and almost impassable as a route. This question of periodic change may have a bearing on the use and disuse of routes over the Karakoram range.

In conclusion, I should like to thank Mr. Shipton very much for his invitation to join the expedition, and for the extremely efficient way in which it was run.

The PRESIDENT: We have been listening to the latest account of this new survey. I think now we ought to go back half a century in order to listen to a description by one who was a pioneer surveyor in this region. You have already heard his name mentioned this evening—Sir Francis Younghusband.

Sir FRANCIS YOUNGHUSBAND: I should like at the start to thank Mr. Shipton for his very kindly and indulgent references to me. For quite fifty years I have been afraid of Shipton and Tilman. It is true that they were not born when I was there, but I knew they would be sooner or later, and that one or other of them might indulge in the sport of picking holes in what their predecessors had done. But they have been kind enough to let me off very lightly, and I thank them most sincerely for that.

You have seen the photographs of that region, and you can imagine the excitement with which I looked upon them, but I must confess that I was disappointed at the result. They were as good photographs as it was possible to obtain, but any one who has actually seen these mountains will, I am sure, admit that they do not give the faintest idea of the impression which those peaks make upon one on the spot. And here I would like to go back to a Presidential Address I gave to this Society about twelve years ago in which I urged the importance of describing natural beauty. I said then that while geology is concerned with the interior of the earth, it is by convention left to geography to deal with the surface. And I argued that describing the beauty on the face of Mother Earth was as much a matter for geographers as the mapping of it. Therefore I very much hope that now that the map of this region is fairly well completed Shipton and Tilman will return there and bring us back real pictures of it. I hope that they will devote perhaps another season to climbing the heights for no other purpose than, as Shipton has said, to see the view. Tilman

stated that this is the finest mountain scenery in the world, and I would corroborate that from what I have seen of other parts of the Himalaya.

I thank Mr. Shipton very warmly for his lecture and I congratulate him on the splendid piece of exploration he has done.

The PRESIDENT: We have another and more recent pioneer with us whose name has also been mentioned this evening, namely, Professor Mason. I should be very glad if he would say a few words to us.

Professor K. MASON: I should like to second Sir Francis Younghusband's vote of thanks to the lecturer, and to congratulate him and the other two who have spoken, as well as the one who is absent, on a very magnificent performance.

I am not homesick to go back, especially when I see these pictures of rope bridges and the like. I always hated them, and I also disliked the rivers. No photograph can bring out their dangers, when they are coming down in flood, with great boulders rolling with the stream, boulders which can easily break a man's leg. They do not invite one a second time. It was not the mountains, but the flood water in the Zug Shaksgam river that eventually stopped our progress.

The PRESIDENT: You will agree with me when I suggest that this expedition was one which was thoroughly worth while, and it is interesting to learn at what very small cost it was carried out. That is a very important factor, because it is always very difficult to raise money for expeditions. What they have done in the course of this expedition has been to fill in a blank upon a map which itself has been produced in the most exquisite manner. I daresay you noted in that enlargement of the Society's map of the Karakoram the intricate detail which was brought out with such clearness. It is a beautiful piece of draughtsmanship and its completion is much desired. This blank has now been filled up with equal detail, and it is a remarkable thing that so small a party should have been able to cover so much ground. It was not easy going, as you have seen for yourselves, but the party successfully departmentalized the work, breaking up into small sections, and in that way they covered a very considerable area indeed.

There is a great deal I would like to say in regard to this lecture, but I will only mention the fact that I have just received a letter from the Surveyor-General of India expressing his very high appreciation of the work which has been accomplished. As we have depended very largely upon the goodwill of the Survey of India, it is very gratifying to find that they have found satisfaction in this remarkable journey.

It only remains for me to offer on your behalf very cordial thanks indeed for the extremely fine piece of work which has been done, and also for the way in which it has been presented to us this evening. Before I close my remarks, I would like to offer all good wishes on the part of this Society to those who are proceeding very shortly on, possibly, a more important and epoch-making adventure still—the conquest of Mount Everest.

A LOCAL EXAMPLE OF THE FACTORS INFLUENCING INDUSTRIAL LOCATION

E. CHARLESWORTH

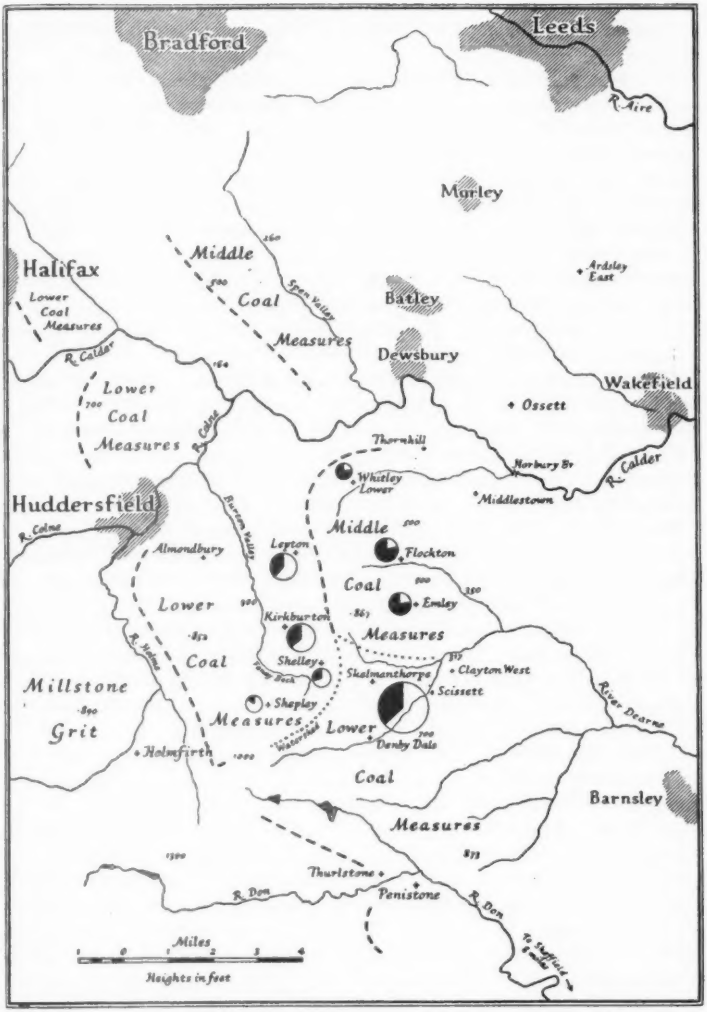
THE subject of this essay is in its detailed aspects of quite minor and local importance, but in that physical, economic and political factors influencing industrial location are here to be seen both in combination and conflict, it is not without some interest at a time when State interference in industrial location is being so much discussed.

In the West Riding of Yorkshire the two great industries of wool textile manufacture and coal mining occupy very widespread areas. To the north of the river Calder the textile area overlaps that of coal mining to the extent of at least 10 miles. To the south of that river, on the other hand, there is a very abrupt eastward cessation of the textile industry, along a line which is closely coincident with the present westward limit of the South Yorkshire coalfield. This break in the nature of industrial activity is all the more remarkable because of its further coincidence with a physical line, the Calder–Dearne waterparting.

The line of division is marked on the accompanying sketch-map. It runs southward from the Calder, near Thornhill, and is formed, as far south as Emley village, by the ridge-top of the oldest, westward-facing, sandstone-capped escarpment of the Middle Coal Measures, which flanks the main Pennine axis to the west. So far this geological line acts as a secondary waterparting, but south of Emley the two physical features diverge, the Middle Coal Measures outcrop turning eastwards, while the waterparting continues southward onto the Lower Coal Measures. The ridge, formed where the two features are coincident, rises as high as 500 feet above the subsequent Burton valley to the west. Its scarp-slope is dissected by small obsequent streams which join Fenay Beck. Its dip-slope bears consequent streams which in the north reach the Calder, and in the south flow into the Dearne.

The break in the nature of the industrial activity is quite visible as one crosses the physical line. The textile area to the west still bears evidence of former mining of the Lower Coal Measures outcrops, but, since the exhaustion of the thin seams late last century, mining has migrated eastwards to the younger outcrops of the Middle Coal, and the villages of Burton valley are now completely dominated by their textile mills. East of the divide on the contrary, mills are absent, and pit-head winding wheels are the typical industrial features scattered between the much less populous villages.

Statistically the industrial break is clearly shown by the 1931 census figures, even though they fail to indicate the daily migration of male miners and female textile workers in opposite directions across the line of division. Emley has 324 miners and 89 textile workers, Flockton 340 and 89, Whitley 174 and 52. Actually these 230 millgirls all travel several miles daily to their work, for the three villages now contain no source of textile employment. To the west of the divide, on the other hand, Lepton has 400 textile workers and 243 miners, Kirkburton 450 and 254, Shelley 200 and 83, Shepley 200



Sketch-map of the relation of drainage to escarpments on the border between the west Yorkshire textile area and the south Yorkshire coalfield. In the circles, the shaded portion indicates the proportion of miners to textile workers in the respective villages in 1931. The largest circle indicates the combined proportions in the villages of Skelmanthorpe, Denby Dale, Scissett, and Clayton West

and 32. These facts have been represented graphically from the 1921 census by Dr. H. C. K. Henderson in a series of maps, one of which has been published.[1]

The first published explanation of the curiously abrupt break in textile activity along this secondary waterparting was put forward by Mr. S. H. Beaver in the first edition of 'The British Isles' (1933). He attributes the "almost sudden cessation of the textile industry south of the Calder . . . to the interruption of the Millstone Grit drainage of the Colne–Calder system by the escarpment formed by certain sandstones in the Lower Coal Measures (Elland Flags) and the Middle Coal Measures (Lepton Edge Rock) the result of which is the inauguration of a new system of drainage—the Dearne headwaters—and consequent lack of large supplies of water, and of deeply incised valleys with power-sites." Thus the vital physical line, as Mr. Beaver points out, is not geological, but topographical—the waterparting, which causes a diminution in the water supply to the east.

The following objections may be raised against this explanation. Firstly, the Lower Coal Measures escarpment to the west also cuts off the Millstone Grit drainage. Nevertheless, Almondbury is the traditional centre of the Huddersfield textile industry.[2] Secondly, in its continuation north of the Calder the Middle Coal Measures escarpment is less prominent topographically, but there also it cuts off Millstone Grit waters from the Spen Valley. This is the traditional and present home of "heavy woollens." Finally, the Middle Coal Measures escarpment, where it forms the Calder–Dearne waterparting, has undergone prolonged fluvial dissection and now bears comparably sized and graded streams on both slopes. The water supply is not abundant, as estate rent-books of the seventeenth and eighteenth century testify. But whereas the scarp-slope villages are a flourishing part of the traditional Huddersfield textile region, the dip-slope villages are not. Actually Flockton and Emley had watermills in the sixteenth century, but they are only known to have been used for flour-making.[3]

Textile sites on all the Coal Measures suffer in the matter of water supply in comparison with sites on the Millstone Grit, but the handicap is not so much lack of water as its comparative hardness. In fact, the particular dip-slope of the Middle Coal Measures in question has no handicaps not shared equally by the other neighbouring Coal Measure areas which yet have succeeded in developing a textile industry. One is therefore led to conclude that the alleged "lack of large supplies of water" and "power-sites" does not explain the absence of the textile industry from this dip-slope, and so fails to account for the sudden cessation of the textile industry east of the Calder–Dearne watershed.

In the second edition of 'The British Isles' (1937), Mr. Beaver has modified his views, incorporating the explanation suggested by Mrs.

[1] L. Dudley Stamp and S. H. Beaver, 'The British Isles,' p. 466, 1st ed., 1933.

[2] The local cloth market was granted to Almondbury in 1297, and was not transferred to Huddersfield until 1672.

[3] Until the Industrial Revolution fulling (*i.e.* cloth-finishing by heavy pressure) was the only process of the textile industry for which more than man-power was necessary. The one building frequently functioned both as corn- and fulling-mill.

Ghorbal (1935).[1] He now ascribes the "almost sudden cessation" of the textile industry "only partly to the paucity of waterpower . . ., but mainly to the long-standing economic differentiation of the Dearne–Don region, where Middle Coal Measures ironstone was formerly smelted, and where textile trades (*e.g.* linen and coarse woollen cloths called 'pennistones') quite early became subordinate to the coal-mining and metal trades of the Sheffield region."

It is true that in Don valley the textile industry has declined in favour of metal trades. Since the substitution of coal for charcoal in the smelting process, the Sheffield region has been exceptionally well favoured for iron and steel making. On the other hand, separated in the late eighteenth and early nineteenth centuries from the textile stimulus of the Lancashire region by the great width of the Derbyshire Pennines, Sheffield had great disadvantages in competition with Huddersfield in textile making. Thus it was that in the course of the Industrial Revolution the former textile industry of the Sheffield region gradually disappeared, while the steel industry expanded. The Sheffield region however is very distant from the Calder–Dearne watershed. It is possible to prove that the influence of Sheffield did not extend to the Calder–Dearne watershed, but was in fact limited northward precisely by the upper Don–upper Dearne divide.[2]

In this respect, Mr. Beaver's reference to pennistones is most interesting. Penistone is an old parish at the head of Don valley, and its constituent hamlets had acquired a name for a special kind of woollen textiles as early as 1595. In 1763 Penistone built its own Cloth Hall. That its textile fame was due more to quality than quantity is suggested however by its population—500 in 1801. There were then four textile fulling mills on the Don, and nearly a score clothiers' weaving establishments on the nearby hills.[3] In 1811 attempts to introduce machinery aroused labour disputes. Although locally mined coal had long been used for heating the dye-vats, steam power was unknown in the valley before 1850. At a time when the Huddersfield textile industry was forging ahead with new inventions and extended plant, the Penistone industry was strangely quiet—"a place of no trade," as a West Riding directory writer observed in 1837. Iron and steel on the contrary was rapidly extending up the valley. Shortly after 1850, two of the fulling-mills were converted into wire-mills and one of the two remaining severely curtailed its textile output. The greatest blow came in 1864 when Cammell Laird began steel production in Penistone and straightway doubled the population of the township with immigrant steelworkers. Hand-loom weaving rapidly died out after the extinction of the fulling mills, of which only one survived into the present century. This exception was significantly located at the very head of the valley at Thurlstone. Here for more than a century Plumpton Mill continued

[1] W. B. Crump and G. Ghorbal, 'History of the Huddersfield woollen industry' (Tolson Memorial Museum Handbook IX (pp. 23–4)).

[2] This divide is marked on the sketch-map by the west–east succession of spot-heights: 1300 feet, 1000 feet, 873 feet.

[3] Information concerning the nineteenth-century history of Penistone mills obtained from Dransfield, 'History of Penistone' (1907), and unpublished MSS. by Mrs. Ghorbal, access to which was kindly granted by Dr. T. W. Woodhead, at the Tolson Memorial Museum.

its specialized manufacture of livery cloths for the royal courts of Europe.[1] But with its extinction the last local outpost of the textile industry is gone, and the Don valley is now given over entirely to iron and steel.

This decline in textiles can only be explained by Penistone's remoteness from the Huddersfield textile centre in that critical century of rapid industrial development before the time of railway construction. Cut off from the valleys leading to Huddersfield by 5 miles of bleak moorland, Penistone built its own Cloth Hall. In so entering into competition with the much larger Hall at Huddersfield it deprived itself of the stimulus of contact with the much greater congregation of textile manufacturers at Huddersfield,[2] who benefited from their proximity to the Lancashire source of new textile inventions. With Sheffield, on the contrary, Penistone had easy down-valley communication. The Penistone textile industry has thus fought a losing battle against the force of well-marked natural lines of communication, and to its defeat is to be attributed its local supersession by the better favoured iron and steel industry.

But those 5 miles of bleak moorland, which were sufficient to cause the decline of Penistone's textile industry by cutting it off from easy access to the Huddersfield centre, thereby effectively prevented any further extension of Sheffield's influence to the north. The traditional and present industrial occupation of the area immediately to the north of the upper Don–upper Dearne divide is abundant proof of the truth of this contention.

In 1931 the four communities of Denby Dale, Scissett, Clayton West and Skelmanthorpe had 1400 textile employees and 785 miners, thus constituting a much more densely populated area than any other part of the Calder–Dearne watershed. Although mining still flourishes at Skelmanthorpe and Clayton West, they are as a whole predominantly textile villages, an admitted exception to the general rule that the textile industry ceases eastward of the Calder–Dearne watershed, and an exception which itself is sufficient to disprove both of the explanations put forward by Mr. Beaver.

The situation of the anomalous area is locally unique, for although it is east of the watershed, it is still on the Lower Coal Measures, textile activity ceasing abruptly where the Dearne crosses the Middle Coal Measures outcrop. But there is no suggestion that either the quality or quantity of water or coal in one Coal Measures division as opposed to the other has any relation to the distribution of textile activity, and it would seem that this coincidence is to be regarded as purely fortuitous.

Textile activity in the Skelmanthorpe–Denby Dale area is at least of mediaeval age.[3] There is record of a fulling-mill at Denby in 1542, which was concerned in a lawsuit in 1573. In view of its hill-top location, record of a watermill at Skelmanthorpe is somewhat surprising, but that a clothier of Denby was fined for assault at the Riding Quarter Sessions in 1639 is quite credible. Meanwhile outcrop coal mining had developed in the region, and

[1] An indication of the highly specialized nature of its activities is offered by the fact that hand-cropping continued here until the closing down of the mill in 1931—a survival unique in the West Riding.

[2] The township population was 7000 in 1801, but surrounding villages, whose populations together totalled 50,000, were dependent on the Huddersfield Cloth Hall.

[3] Yorkshire Archaeological Society Records, vols. II, V, LVIII, LIX.

even before the days of steam power it was of great use for farmhouse cloth making, in that it provided fuel for domestic purposes and for the dye vats.[1] Families still active to-day in the textile industry are mentioned as early as 1770. The first wool textile inventions of the Industrial Revolution were readily imported, four scribbling and spinning mills being installed on the Dearne at the beginning of last century. In 1827, with the introduction of the steam-engine, local coal, whatever its previous importance, now became a quite invaluable asset to the industry. In 1851, two firms from the area were represented at the Great Exhibition, and shortly afterwards, while the spinning mills were being enlarged, four power-loom weaving factories were built. In the wool textile industry the mechanization of the weaving process was thus delayed almost fifty years after that of spinning. In the interim hand-loom weaving developed most rapidly in an endeavour to keep pace with the spinning machine. Once power looms came in, hand weaving declined, but in 1890 there were still 170 hand-loom weavers in Skelmanthorpe, and even to-day the craft is casually practised for the production of home-made clothes.[2] The factories however have been most progressive, and, thanks to specialization on fancy goods, they have been more prosperous than in the Huddersfield area itself, so that since the Great War they have extended output and absorbed unemployed miners, an expansion now only too rare in the West Riding.

The explanation of this vigorous textile development at the head of Dearne valley before the time of railway construction is attributed by the industrialists themselves essentially to the easy road communication over the low and narrow watershed, and down Burton valley to Huddersfield, the traditional cloth market for the area. This facility is to be contrasted with the difficulty of communication over the Don–Dearne divide with the Sheffield region. No metal trades have developed at the head of Dearne valley. That the Don–Dearne diyide was an effective industrial boundary is thus clear from the fact that the one exceptional textile development east of the Calder–Dearne watershed is located precisely at the southern end of that watershed, in the area actually nearest to the Sheffield region, but yet effectively cut off from that region's influence. From this failure to extend its influence north of the Don–Dearne divide, it is clear that Sheffield's industrial history is irrelevant to the development of the Calder–Dearne watershed. There is no justification whatever for attributing the cessation of the wool textile industry south of the Calder to the development of the metal trades of the Sheffield region.

The exceptional development of the textile industry in the Skelmanthorpe–Denby Dale area is also further proof that the diminution of water supply east of the Calder–Dearne watershed has not been a factor of sufficient importance to preclude textile activity. Evidently these hills put forth springs

[1] As Defoe remarked: "Such has been the bounty of nature to this County (the West Riding) that two things essential to the (clothing trade) . . . are found here, and that in a situation which I never saw the like of in any part of England ; . . .—I mean, coals and running water on the tops of the highest hills."

[2] The cottages with their enlarged window space still bear witness to this early nineteenth-century drive for hand-loom weaving efficiency.

copious enough for scouring, and the Dearne had sufficient head of water to turn many mill-wheels. Local coal mining—not a rival occupation, as Mr. Beaver would suggest—also contributed directly to the textile development before the modern era. And subsequently, apart from affording a new power supply, it has been an invaluable means of increasing the water supply, the Skelmanthorpe factories now obtaining pure ground water from the local pits for the cleansing processes. At Emley a similar supply awaits a similar exploitation. There, too, what is now a handicap to the colliery could become a boon to the factory.

As mentioned by Mr. Beaver (Tankersley) ironstone was certainly exploited in the past on the dip-slope of the Middle Coal Measures escarpment.[1] But this activity, fostered by the monasteries of Fountains, Byland, and Rievaulx in the twelfth century, reached its fullest development in the thirteenth, and, unlike its continuation north of the Calder and south of the Dearne, the outcrop here began to be exhausted in the fourteenth century. The last recorded ironworks fell into disuse in 1624. In the century of its greatest importance the iron industry certainly challenged agriculture as the leading occupation of the area. But in view of its early decline there are no grounds for asserting that the iron industry was in any way responsible for the subsequent lack of development of the textile industry in the Emley–Flockton area.

In the same area coal mining is of equally early origin and has been much more persistent. Recorded at Lepton in 1357, there are frequent references to its progress on the dip-slope in succeeding centuries, and by the early eighteenth century shafts in both Emley and Flockton had reached a depth of 300 feet. Its greatest expansion followed the Industrial Revolution, until exhaustion called a halt at the end of last century. Thus here too, as in the Penistone and Skelmanthorpe–Denby Dale areas, the textile stimulus of coal mining has always been present.

This Middle Coal Measures area always retained the agricultural superiority over neighbouring areas which is clearly indicated by the Domesday returns, and it is evident that, with the added occupations of coal and iron mining, it must have been comparatively wealthy and densely populated in the thirteenth and fourteenth centuries. Even as late as the poll tax returns of Richard II's reign the outstanding importance of the area is indicated. Indeed, there is ample evidence that local cloth making was then yet another subsidiary occupation, for the poll tax was paid by a webster of Empley and two tailors of Flockton, while "Thomas of Emley" paid 1*d.* ulnage in 1367, and "John the walker" of Flockton twice receives mention in fourteenth-century records. And yet despite this certain beginning, a beginning both better documented and better favoured by recorded circumstance than that of most Pennine textile areas, the textile industry of the Emley–Flockton area failed to acquire any commercial importance, always remained subsidiary to the other occupations of the area, and completely disappeared with the onset of the Industrial Revolution.

[1] See D. A. Wray, 'The mining industry in the Huddersfield District,' 1929; Tolson Memorial Museum Handbook VI; and C. H. Vellacott, 'Mediaeval mining and smelting,' V.C.H., Yorks II.

It is this continuous failure of the textile industry of the Emley–Flockton area to acquire any commercial importance which is responsible for the present sudden cessation of the textile industry east of the Calder–Dearne watershed. And the cause of that failure is, it is here submitted, neither simply physical, due to the question of water supply; nor purely economic, due to the free competition of rival industries; but political—the result of local and national government legislation.

The eastern slope of the Calder–Dearne watershed is, at its northern end, but 8 miles distant from Wakefield, with which it has excellent communications by means of an early mediaeval ridge-top road through Middlestown to Horbury Bridge. At the time of the first records of scattered and subsidiary rural cloth making, we know of a very much more advanced development at Wakefield.[1] An Anglian settlement, Wakefield became the centre of a great manor which covered much of the West Riding. In 1180, the Norman lord granted a market and made it a corporate town, and in 1204 it obtained a royal charter. Its manorial mill is mentioned in 1240, and by 1258 it required, and obtained, a second annual fair. In 1297 five mercers of the town were taxed, and the poll tax returns clearly demonstrate the prosperity of the town, and its essential dependence on cloth making. This urban woollen industry was not only on a much larger scale than the local rural production, but it also differed in that it was a gild industry. As such it obviously enjoyed the benefits of urban cooperation in production and marketing. Moreover it shared, along with York, Beverley, and other northern gild towns, the urban monopoly of gild production first granted by Henry II to "York and other my demesne burgs," by a statute which was repeated at the beginning of each new reign in the three succeeding centuries.

In the south of England [2] the legal urban monopoly of cloth making became obsolete, with the early evolution from the essentially urban gild system of production to a domestic system permitting the decentralization of industry into rural areas. In the north, on the contrary, the domestic system appeared much later and to a much smaller extent. The urban gild industry remained active into the seventeenth century. But meanwhile, in the Pennine hills, local rural cloth making, which originated simply to supply home demand, found that it could successfully compete on a commercial scale with the urban industry. This was due to the freedom of the rural areas from the gild regulations which increased urban costs of production. Rural cloths, if inferior, were cheap and in much demand among the poorer classes. Such commercial rural development was strictly illegal, but it was conducted quite openly, and it was so successful that whereas in the 1396 Ulnager's Rolls Wakefield was Yorkshire's leading cloth-producing centre, in 1469, when account was first taken of the separate rural production, Wakefield's output was exceeded by that of the Halifax region. Two years later Almondbury also surpassed Wakefield.[3] An interesting comparison of the quality of urban and rural cloth is revealed by the item of Thomas Cromwell: "to remember such as

[1] See J. W. Walker, 'Wakefield: its history and people' (1934). S. H. Waters, 'Wakefield in the seventeenth century' (1933).

[2] See E. Lipson, 'The history of the woollen and worsted industries' (1921).

[3] See H. Heaton, 'Yorkshire woollen and worsted industries' (1920).

have caused cloths to be flocked in the North, and to know the King's pleasure." Honest Wakefield had only 13 cloth adulterers, while the Halifax region had 182, and Almondbury 113.

Rural competition had become so effective in the Tudor period that the northern gild towns had to seek government aid, in order to preserve their industry. Reference was made to legislation of previous centuries, and new statutes were secured. Henry VIII and Edward VI both gave gild-town merchants freedom from tolls in any fair in England, and in 1563 the Weaver's Act of 1555, which limited rural cloth makers to the possession of only two looms, was extended to the North. Meanwhile Wakefield used its own powers to impose heavy tolls on rural cloth offered for sale in the town market.[1]

Urban attempts at enforcing a legal monopoly of cloth production were on the whole unsuccessful. It proved impossible to check the number of looms worked in the remote hill farms, while the urban tolls only drove producers to other and free markets. Gild-town trade thus still further declined, while the rural advance continued. But, it is here suggested, while the gild towns suffered from their own action, the rural areas on the immediate outskirts of those towns would suffer even more severely. Clothmakers in these areas, of which Emley–Flockton is an outstanding example, if they took cloth to market had either to pay the Wakefield tolls or go the long distances to the free markets in the hill centres. In any case it would be very dangerous to expand beyond two looms per household, for administration of the 1563 Act was obviously most effective in the immediate neighbourhood of the gild towns. The Emley–Flockton area thus fell a victim, owing to its geographical position, to the trade rivalry between urban Wakefield, and the Pennine rural regions. Immediately north-west of Wakefield the rural industry flourished, because the Dewsbury, Batley, and Ossett producers had recourse to the free fair at Ardsley.[2] South-west of Wakefield the Skelmanthorpe–Denby Dale area was unaffected by the gild town because it had then no direct road communication with Wakefield, its sole connection being with the free markets at Almondbury and later at Huddersfield. But immediately west-south-west of Wakefield, the Emley–Flockton area was fully exposed to the urban influence. The Yorkshire Archaeological Society's Records have no mention of cloth-making activity in the Emley–Flockton area, in the period of the enforcement of the Tudor monopolies. Only one "journeyman of Flockton" is mentioned (1641), apparently locally unique in having "served as an apprentice by the space of seven years." The Emley Township Books [3] contain continuous records from 1595, but no mention is made of weaving until the eighteenth century. Apparently in that early modern period the Wakefield tolls and the fear of legal action [4] were a successful deterrent against commercial development of cloth making in the Emley–Flockton area, whose

[1] These were: 8*d.* per broadcloth; 4*d.* narrowcloth; 1*d.* Kendal-cloth. They were still collected in 1700.

[2] This fair, traditionally known as Lee Gap, obtained its charter from Henry I. It was sufficiently powerful to complain of Wakefield's rivalry in 1656, and is still held annually to-day.

[3] Copied by Mr. J. Charlesworth, F.S.A., who kindly granted access to his manuscript.

[4] As late as 1764 Lydia Longbottom of Bingley was publicly whipped through Wakefield market for reeling false and short yarn.

continued prosperity therefore depended on a concentration on agriculture to supply the food requirements of the neighbouring manufacturing areas.

In the late seventeenth century Wakefield's attempts to enforce her legal monopoly of cloth manufacture at last ceased, and the town realized that her future prosperity would more readily be secured by industrial specialization and by serving the hill regions as a distributing centre. General tolls were abolished, and in 1712 the town built one of the earliest of the northern Cloth Halls. A century of commercial prosperity ensued, and local cloth production came once more into evidence. But the old spirit of urban gild exclusiveness still remained to perpetuate the same harmful effects. One of Wakefield's attempts at specialization was the introduction of fine worsted making (locally known as "tammy making"). In 1777 a number of clothiers contributed towards the erection of a separate Tammy Hall for the marketing of the new product. Unfortunately they excluded any one who had not served a seven-years' indentured apprenticeship to the trade from offering goods for sale inside or within 10 miles of the building. Inevitably the experience of previous centuries was repeated. Worsted migrated to the hill regions, and by 1820 Tammy Hall was disused for lack of trade.

Thornhill Parish Registers [1] clearly reveal the particularly harmful effect of the rise and fall of Wakefield's worsteds on the Emley–Flockton area. Thornhill parish then included Whitley, part of Flockton, and Middlestown. In Thornhill township and Whitley (the extreme north and west of the parish, nearest Huddersfield and most distant from Wakefield) cloth making had at last begun to develop on a commercial scale in the late seventeenth and early eighteenth centuries. In Flockton and Middlestown on the other hand, cloth making was still subsidiary to agriculture, mining and furniture making. But in 1782, the following surprising entry appears: "——, Middlestown, farmer and Tammy," and in the next few years such tammy making rapidly spread westwards over the parish. The records cease in 1799, but in the last decade it is possible to trace a decline of local tammy making as sharp and sudden as its appearance. Once more the Emley–Flockton area suffered from Wakefield's intolerance.

The Emley Parish Registers throw light on yet a later stage in the development of the industry. In 1789 the Township Books record 42 farmers and 5 weavers in the village. The Registers include a large number of Skelmanthorpe entries. They first cite occupations in 1813. Already the Skelmanthorpe entries of clothmakers, although only accounting for part of that village, greatly exceed those of Emley. In Emley, cloth making was a subsidiary occupation, as evidenced not only by the relative numbers engaged in other occupations, but also by the fact that Emley cloth makers are invariably termed "weavers," while Skelmanthorpe's entries distinguish between "weavers" (employees) and "clothiers" (employers). The records continue to 1836 and cover part of the period in which factories were being built and steam engines introduced into Skelmanthorpe.[2] By 1836 Skelmanthorpe entries in the register are much more numerous, while Emley's textile entries

[1] Published by the Yorkshire Parish Registers Society.

[2] In this respect it is interesting to note that one "Field," a "Clothier" hitherto, is termed "manufacturer" in 1818. The firm is now the largest in the area.

remain stationary. This relative decline reflects the fact that Emley did not build a spinning mill and consequently had no demand for increased hand-loom weaving. Indeed the machine products of other areas were so cheaply imported that it soon became unprofitable even to continue the traditional home cloth production. Thus before the invention of the power loom sounded its general death knell, hand-loom weaving was already disappearing from Emley.[1] Instead the women went out to the mills of the Skelmanthorpe–Denby Dale area, while the men concentrated on land-working and mining.

With the failure to build a mill at Emley or Flockton, the Industrial Revolution thus saw the extinction of cloth making on any scale in the area. The only explanation of that failure lies in the centuries-old handicap of proximity to the Wakefield gild industry, whose exclusiveness expelled all commercial textile initiative from the Emley–Flockton area. In Penistone the force of physical factors militated against successful textile development. In the Emley–Flockton area physical factors were in favour. Here the adversaries were the much more potent forces implicit in a clash of human will.

In 1826, Wakefield manorial corn mill obtained a verdict forcing the inhabitants of Horbury and Ossett to continue bringing their corn to grind. So late did Wakefield's feudal tradition remain operative in the corn trade. In textiles the same forces were even more effective, as a prominent citizen realized as early as 1866:[2] "the aristocracy of Wakefield who had already made their fortunes (by commerce in the eighteenth century) refused to permit mills or factories to be established there: they were well content . . . to attend the markets in other towns, but they would not have manufactures brought to Wakefield. Indeed they went so far as to have it inserted in their indentures of apprenticeship that those thus bound should not exercise their trade within . . . ten miles of Wakefield. This sent the manufacturers to Leeds, and . . . Bradford. It was however but a short-sighted policy, . . . after a while they themselves removed from the town, and left poor Wakefield without its aristocracy, and without the manufacturing wealth and importance which otherwise would have remained here."

Perhaps the most notable individual victim of Wakefield's exclusiveness was the man later known as Sir Titus Salt, by whose expulsion Wakefield lost "Saltcalder" and Bradford gained Saltaire. In the Dewsbury–Batley area, whose "shoddy" tendencies were evident in the above-mentioned "item" of 1533, Wakefield's worsted apprentices were not missed.[3] In the Emley–Flockton area, the landowners are locally said to have been hand-in-glove with the nearby Wakefield aristocracy, to have encouraged farming and mining, and discouraged any attempt at commercial textile development. Their influence was irresistible, and no mills were built. Coal mining was

[1] Here very few houses increased their window space; the typical small-windowed homestead is predominant.

[2] Rev. C. Camidge, 'A history of Wakefield: its industrial and fine art exhibition,' 1866.

[3] The only nineteenth-century mill building associated with the eastern slope of the Calder–Dearne divide was an offshoot of Dewsbury's shoddy industry at Whitley. There two small scribbling mills were built on the stream early last century, but were unprofitable and fell into disuse within forty years owing to the difficulty of communications.

intensively developed,[1] but mining of these thin outcrop seams sensibly shortens its days with every intensification of development, and it is likely that practicable seams will be exhausted before the end of the present century. Then, for lack of manufacturing industry, the area will become purely agricultural, and form a still more noticeable gap in this otherwise densely populated part of the West Riding. For if the men can find no alternative employment they will presumably migrate. At present their womenfolk to the extent of 230 are taken by bus daily to their textile employment at least 4 miles outside the area. If the men have to migrate for lack of employment the women will necessarily accompany them, the last connection of the area with the textile industry will be broken, and the "almost sudden cessation of the industry south of the Calder" will be complete. The only alternative to the emigration of labour is the immigration of new industrial activity. The abundance of water is here an annoyance to the collieries. Coal is still supplied locally, and in any case will always be readily obtained from Wakefield. The labour supply is here with traditional textile skill bred in it. Wakefield's aristocracy is gone. At last it would seem that the Emley–Flockton area is free to hope that some industrialist will reap the long-deferred textile harvest, whose failure to mature here in the past is apparently to be ascribed to the repressive urban influence.

The Council have awarded to this Essay the prize offered for an Essay of not more than 5000 words: either a critical survey of recent additions to knowledge in a limited geographical field, or a discussion of some problem in its geographical aspect.

The conditions of the competition for 1939 were announced in the Journal for March 1938, p. 290.

[1] Thus the characteristic domestic architecture of Flockton, Whitley and Middlestown is the late Victorian brick terraces built to house the miners : a startling contrast with the villages of the Skelmanthorpe–Denby Dale area.

APPLICATION OF GEOPHYSICAL METHODS TO THE STUDY OF THE GREAT BARRIER REEFS

PROFESSOR H. C. RICHARDS

FOLLOWING upon the presentation of Mr. J. A. Steers' paper "The coral islands and associated features of the Great Barrier Reefs" to the Royal Geographical Society, the valuable discussion on 7 December 1936 brought out many interesting points. Some remarks made by Mr. Michael Spender as to the application of geophysical methods call however for some reply.

At that time boring operations had not been carried out on Heron Island, but the results of the Michaelmas Cay bore were well known. Mr. Spender (*Geogr. J.* 89 (1937) 142), after pointing out that the study of the island reef had brought out certain anomalies between different reefs, said:

> "Future work must be directed to the main problem, that of the Barrier Reef as a whole. To that end I doubt whether deep boring should be undertaken again without preliminary prospecting, either with numerous shallow bores or with modern geophysical methods. I have consulted with some of the experts, Dr. Bullard, of Cambridge, and Dr. Brockamp, of Potsdam, and they agree that both pendulum gravity surveys and seismic soundings could be used in the conditions familiar to me in Queensland. These I think are likely to be the most profitable tools to use on this resistant strip of coral: and Lizard Island is a proper base from which to use them."

After thirteen years' activity on the part of the Committee, and in spite of much intense work by marine biologists, physiographers, and geologists, we found ourselves with little specific or definite information on any points except those provided by the deep bore at Michaelmas Cay and by the mapping of the coral cays, etc. The big questions as to the nature of the reefs below the surface, the thickness of the coralline mass, the chemical composition, the nature of the material below the coral and the depth and surface features of the old underlying "platform" were still with us.

The deep bore at Michaelmas Cay had without doubt been much the most informative investigation and moreover had indicated a world-wide inability among coral reef authorities to forecast its results. So unexpected were they as to the unconsolidated and nondolomitized nature of the coralline material, and so interesting as to the character of the underlying quartz sands, that it was a matter of great concern to know whether or not the bore was at all representative in its information. The Committee after much consideration therefore decided upon another deep boring activity, this time at the southern end of the Barrier Reefs area—Heron Island (lat. 23° 26′ S., long. 150° 57′ E.), and in a general way hoped ultimately to bore at the northern end and so to gain quantitative information after penetrating the coralline material in the central, southern, and northern portions of the Great Barrier Reefs.

The results of the boring operations at Heron Island are now in course of publication by the Great Barrier Reef Committee and recently the Royal Society of New South Wales [1] has published "Some problems of the Great

[1] *Jour. and Proc. Roy. Soc. N.S.W.*, vol. lxxi, pp. 68–85.

Barrier Reef." These two publications by the writer contain much information pertinent to this question under consideration. It may serve a useful purpose to say that the boring at Heron Island penetrated to a depth of 732 feet, the first 450 of which were coralline material almost identical in its physical and chemical nature to that met in the top 437 feet at Michaelmas Cay, 700 miles to the north-west. The calcareous quartz sands underneath were passed through to 732 feet and, except for certain hard calcareous bands up to 30 inches thick, were identical with the corresponding material at Michaelmas Cay.

The Committee has for at least four years given very close attention to the question of invoking the aid of geophysical methods, especially for determining the thickness of the coralline matrix and the depth of the old rock platform. We have been hopeful of finding a use for both pendulum gravity surveys and seismic soundings, but with the evidence already gained by the Michaelmas Cay boring we preferred to defer the application of geophysical methods until we knew more as a result of very positive old-fashioned boring methods applied to Heron Island. We had not been able to learn of any gravity method that was at all reasonable in its cost of operation in these regions; and moreover our problem was to see any great value in a gravity survey if we have, as at Michaelmas Cay and Heron Island, about 450 feet of fragmental material resting on some unknown thickness of loosely coherent siliceous sand containing abundant foraminifera and calcareous shell fragments.

The most important thing we wish to know is the thickness of the coral matrix and its physical condition. The disparity between the densities of the coralline material and that below it did not appear to be sufficiently great, bearing in mind the upper thickness, to enter into expensive operations. With regard to seismic tests we were able to establish close contact with Mr. M. Modriniak of the Department of Scientific and Industrial Research in New Zealand and at quite a moderate expense we could have applied both the refraction and reflection methods to our area, especially with a view to determining the depth of the old rock platform. We considered however that we should be well advised to have certain positive information as to the depth of the platform before applying seismic methods, and if these in their results correspond with the boring results, we should feel confidence in using the seismic methods in many places over the Barrier Reefs area, in order to determine not only the depth of the old rock platform but also the general character of its surface.

As has already been indicated, the boring encountered several very compact siliceous limestone bands, and while account could no doubt be taken of these, and the effects either discarded or obviated (especially when it is known they are there), one feels that the postponement of the seismic tests was not altogether without wisdom. The recent application of seismic methods off the coast of Massachusetts, U.S.A., by Ewing Miller and others,[1] has been of great interest in this connection, because it has been shown that both the refraction and reflection methods may be used to advantage in determining the thickness of unconsolidated and semi-consolidated material near

[1] *Bull. Geol. Soc. Amer.*, vol. 48, No. 6, 1 June 1937, p. 753.

the edge of a continental shelf, and the depth of the old rock platform at great depth may be ascertained. The more important results came from the refraction measurements, and in the present state of development the method is not applicable in water deeper than 100 fathoms. There is little doubt that in the near future we shall be able to apply seismic methods to great advantage in the Barrier Reefs area, more especially if we have really positive evidence from boring methods in one or two key positions.

THE SAHARA

We have received the following letter from the Hon. Francis Rodd, and from Dr. J. D. Falconer the note on the Report of the Anglo-French Forestry Commission. These were shown to Professor Stebbing, whose reply is also printed below.—ED. *G.J.*

MAY I say how much I agree with the comments of your reviewer "J. D. F." with regard to desiccation in his review of Professor E. P. Stebbing's book on 'The forests of West Africa and the Sahara' in the *Journal* for December 1937? While the Sahara has probably advanced in the course of the last ten centuries and while the climate in the course of the last twenty centuries has probably gone drier, the order of magnitude of change within a century and still more within a generation is probably not anything like as great as is implied in Professor Stebbing's writings. There is little doubt that desert conditions, especially along the southern fringe of the Sahara, ebb and flow over periods of a few years as well as over longer periods. My very distinct conclusion as regards certain parts of the sub-desert thorn forest and bush north of the centre part of the northern Nigerian boundary is that vegetation has advanced rather than retreated, within my own experience as well as according to native accounts. In that promontory into the Sahara of the sub-desert zone which is called Damergu and Tegama, south of the Aïr mountains, there has been a degradation of tree and bush vegetation owing to extensive cultivation of grain during the last fifty years of the last century. Since the War however the human population has declined and in this part of the sub-desert zone as well as farther east the cattle population has also declined very considerably, with the result that deforestation has been arrested and in the western part of the area the desert seemed in 1927 to be retreating.

In the desert zone itself of the southern Sahara, occupied by the Aïr and Ifoghas mountains and intervening desert, there is evidence of drier conditions in some parts having led to the death of trees, but there are on the other hand areas in which vegetation has undoubtedly increased. In the latter districts small trees and pasture flourish where there is no visible evidence of large specimens of trees ever having existed.

The very variable incidence of rainfall in the southern Sahara and southern sub-desert makes for very misleading appearances; it renders any conclusions about the rapid advance of desert conditions very dangerous except over longish periods of observation. For years at a time no rain appears to fall in some districts but more than usual in others. A traveller in one of the areas where no rain has fallen for several years will inevitably be led to the conclusion that

vegetation is declining. If that traveller has not happened to cross another area where rain has fallen consecutively for several years after a dry interval his judgment will be biased. The local evidence of Europeans is also curiously unreliable in many cases. The European, especially in the dry seasons, is always apt to exaggerate desiccation and the advance of the desert. More especially is it dangerous for a visitor to come to definite conclusions unless he has spent more than one rainy season in the desert and seen how vegetation appears almost miraculously as a result of one brief shower falling for no apparent reason, for instance on a certain patch of gravel desert which looks as if it never had supported or ever could have supported a living plant. It has been my good fortune to see this in two such rainy seasons and, without pretending to such knowledge as Professor Stebbing has, I cannot but agree with your reviewer's comments on the subject rather than with Professor Stebbing's conclusions.

FRANCIS RODD.

THE REPORT OF THE ANGLO-FRENCH FORESTRY COMMISSION

The Report of the Anglo-French Forestry Commission on existing conditions along the northern frontier of Nigeria, recently published in Lagos, is a document of considerable geographical interest. The opinion is widely held in France that since the Quaternary pluvial period the Sahara and its borderlands have undergone a progressive desiccation which is continuing at the present day, while in Britain there has been of recent years much speculation, not unmixed with alarm, over the alleged advance of the desert upon the northern provinces of Nigeria, with consequent diminution of rainfall and failure of the water supplies. The Nigerian Government and the Administration of the French Niger Colony deserve great commendation for appointing a joint commission "to inspect the country on both sides of the boundary and to collect all available data from which conclusions can be drawn as to the progress of desiccation . . . and the extent to which desert conditions are being created, and what is causing these conditions."

In the beginning of 1937 the Commission toured the country on both sides of the frontier, from Sokoto eastwards on the Nigerian side by way of Katsina, Kano, and Geidam to Lake Chad, and back on the French side from N'Guigmi by way of Zinder and Maradi to Niamey on the river Niger, with a digression as far north as Agadès. A diary is given which records the observations of the Commission and other significant information. "In each town the Commission questioned the local chiefs and their councillors on changes in water supply, on sand displacement, on agricultural practice, and on any indication of a change in vegetation types."

The unanimous conclusion of the seven commissioners is that "under present climatic conditions there appears to be no imminent and general danger of desiccation . . . (but) there is unquestionably an impoverishment of the sylvan conditions of the country . . . due almost entirely to uncontrolled expansion of shifting cultivation."

On the question of sand invasion from the Sahara the Commission reports that no instance of sand movement on a large scale was noted along the route. It was observed however that much of the country visited is covered with sand, sometimes in the form of a continuous sheet and sometimes rising into dunes, but with a few minor exceptions in French territory all the sand is at the present day anchored by trees and grass. "These sands date from the Quaternary period and their form is not now subject to any change other than that due to water erosion." Sand displacement by the wind occurs locally on farms that have

been hoed and weeded, on cattle tracks, and in towns and villages where the surface has been disturbed by traffic.

Thus the Report of the Commission confirms the original observations of the writer, who many years ago recorded in 'The geology and geography of Northern Nigeria' the occurrence of ancient dunes and sand drifts on the frontier and as far south as the latitude of Kano, and deduced therefrom that the Central Sudan is at present enjoying more humid conditions than it did in the prehistoric past.

With respect to the alleged diminution in rainfall and water supplies the Commission found that the year 1936 had been an exceptionally wet year. The level of Lake Chad had risen, many rivers formerly dry had again begun to flow, and the wells, if there had been any lowering of the water table, had now returned to their former level and in some cases had risen above it. The Commission is careful to point out that this does not constitute proof of increasing humidity, as the records show that the climate is characterized by an alternation of humid and dry periods of short and varying duration.

In the matter of the alleged deterioration of the forests the Report of the Commission supports the opinion of Professor E. P. Stebbing in his recent book on 'The forests of West Africa and the Sahara': that on account of the practice of shifting cultivation much of the natural woodland has been so seriously degraded in quality that it is of very little use and it has not been replaced by farmland of real value. The Commission recommends the protection and rehabilitation of the existing forests and the replanting of derelict areas on the European model. It was observed also that farming is most prosperous and living conditions most stable where there is a system of permanent cultivation, notably at Kano. The Commission is of opinion therefore that the standards of living and farming naturally attained at Kano could be reached elsewhere by the organization of "permanent farmlands, properly demarcated, regularly manured, adequately timbered with trees of economic value and with an assured supply of water," and that the local displacement of sand on open farms could be ameliorated by the establishment of shelter belts at right angles to the winds, by the planting of hedges along the boundaries, and by the maintenance in the farmlands of a fairly large number of useful trees as in the country around Kano and Zinder.

The Commission has been able, with the help of modern equipment, to make a very complete reconnaissance of the area in a very short time. While such matters as the proper use of the land and the conservation of the forest may require much fuller consideration, it is gratifying to be able to record that there is no evidence of the diminution or failure of surface or underground water in Hausaland or Bornu, and no danger of the northern portion of British Nigeria being reduced to desert in the immediate future. J. D. FALCONER.

THE ADVANCE OF THE SAHARA

I have read with interest the review on that part of my book 'The forests of West Africa and the Sahara' which the reviewer considers to be of main geographical interest. It would appear to be based on two assumptions: firstly, that as my visit to Northern Nigeria was made in the hot season I was perhaps not in the position to distinguish the dried-up condition of agricultural land or even that of the savannah from its appearance when the rainy period ensued; Mr. Rodd also alludes to this point. Secondly, that I adopted the French view of the history of the desert, that there has been a slow progressive desiccation of the Sahara and its borderlands, which is continuing to the present day.

As regards the first assumption, during my first two years' service in Chota Nagpur as a young Indian Forest officer I spent the hot months of April to mid-June living under canvas on fire-protection work in the forests. I am not likely to forget the first burst of the monsoon under which the parched-up agricultural and forest land became green in a night. With such an upbringing I took it for granted, perhaps wrongly, that my readers would be well acquainted with the contrasts presented by such a countryside as Northern Nigeria in the hot weather and rainy season, and would not mistake fertile agricultural land for degraded desert areas, even in the hot season. Nor, it may be added, dry-season tracks practicable for a motor car for the morasses they become in the rainy months. Secondly, with reference to the French point of view, I had written my last field note on the subject before I had even heard of it. My first intimation came from my talks after arrival at Colomb Béchar with Administrateur en Chef Monsieur A. de Loppinot and Lieutenant Eon. It was subsequent reading and investigations in Paris that brought me cognizance of what your reviewer J. D. F. calls the French view, although this view has quite a number of French dissentients, who hold the old ideas based on those of aforetime historians.

During my service in India I had carried out investigations into erosion and its consequences. I had studied aspects of the great Sind Desert, the stark countryside of Baluchistan and parts of the neighbouring Persian arid areas, eroded areas in the outer Punjab hills, and the historic barren regions of the Salt Range and the country on the banks of the Jhelum, which, as recorded at the time of Alexander the Great's invasion of India, were then clothed with a tall vegetation affording umbrageous shade to the troops; and as a last instance, that dreadful area of howling waste stretching over some million acres along the Jumna and Chambal rivers in the United Provinces in India. It proved of considerable interest therefore in Northern Nigeria and in the French Colonies beyond to have the opportunity of studying an earlier phase, the degradation actually in progress to the desert types known to me in India. I think the reviewer's assumption that all is well with the fertile plains of Hausaland is, in view of what is taking place at the present day at an increasing rapidity, not only misleading but extraordinarily dangerous.

This brings me to the remarks about "Advancing Sahara" or "Encroaching Sahara." In my "Man-made desert in Africa" [1] I have already admitted an inadvertent mistake in using the latter term for my address to the Royal Geographical Society in 1935.[2] I had never imagined that I should be credited with the idea that the Sahara was advancing in great waves like the incoming tide of a sea. The main theme of my paper and book is forest degradation which leads to erosion, and as a last stage to barren land—sand, or sheet rock, or other form, depending upon the locality and environment. Owing to the presence of a great desert to the north the process is hastened by blown sand in the colonies on the southern edge of the Sahara.

The opening paragraphs of the Report of the Anglo-French Forestry Commission deal with a description of the search for advancing sand waves—"les vagues de Monsieur Stebbing"—and sand-dunes. What the Sahara does within itself in the shape of the formation of sand-dunes and so forth is doubtless of interest to the geologist, but is not a matter of practical concern to the forester. What is bringing about additions to the Sahara is what your reviewer correctly quotes as "the belt of country on the southern margin of the desert [which] is

[1] *Journal* of the Royal African Society, Supplement to Vol. XXXVII (1938), No. CXLVI.

[2] *Geogr. J.* 85 (1935) 506–24.

rapidly deteriorating. The wells are failing, the herbage is withering, the pastures are being sanded over and the scanty inhabitants are being forced to migrate." A state or affairs by no means new to the Sahara and in full agreement with opinions I have expressed.

The views enunciated by Dr. Falconer and by Mr. Francis Rodd on the subject of water supplies and their variation, or intermittency as I express it, would appear to add some valuable proof to the proposition I have advanced on this subject in my paper, "Man-made desert in Africa." It is however impossible to agree with the former's theory which he explains as follows: "That there exists in Nigeria evidence of a geographical nature which indicates that while in the immediate past the desert unquestionably extended into the northern provinces, the present régime of periodic rains represents a return to more humid conditions. This theory offers a means of escape from the predictions of evil. The evidence upon which it is based has never been refuted, but it has been persistently ignored by the desiccationists and only of recent years has it received some tardy recognition in France (Gautier, E. F., 'L'Afrique Noire Occidentale,' 1935). It follows from this theory that the dry deciduous forests of the northern districts, as well as the scrub and grassland with scattered trees, are not to be regarded as degenerate and 'on the downward grade to pure desert' ('Forests of West Africa and the Sahara,' p. 11), but rather as struggling to assert themselves in an unfavourable environment."

This is a startling statement. The view is now widely accepted that Africa is suffering at the present day from increasing erosion threatening the water supplies of considerable tracts of the country, due to man's upsetting Nature's balance by an ignorant over-utilization of vegetation and soils, and now with increased population and flocks, proceeding at a quickened rate. It is suggested by Dr. Falconer, Mr. Francis Rodd, and others that the present periodic rains represent a return to more humid conditions, and that therefore the desert is now receding.

I have already put forward the suggestion that once Nature's balance has been interfered with to the point at which the rainfall becomes irregular and unreliable, a stage has been reached which I suggest should be termed the Intermittent Rainfall Stage; the stage at which man can no longer rely either on the amounts or the times at which the rain will come. I have also suggested that this intermittency will, or has in the past, gradually make its appearance over a long period of years. The practice of the Damergu inhabitants who, as stated in the Anglo-French Forestry Commission's report, may have to resow the seed of their crops as many as twelve times owing to unreliable rainfall and blown sand is a fair example of my meaning. But the rain however variable still continues to arrive.

Both Dr. Falconer and Mr. Rodd refer to areas on the French side, once more heavily populated, now being left tenantless by migration. The people left because, after they had to give up farming, their stock reduced the remaining savannah to such a condition that it only provided food for goats. Since they were cattle owners and probably grew enough food crops for their requirements they migrated from the impoverished areas, just as their ancestors had done down through the ages. Now when man left these areas all the savannah type of tree had not been killed out. The living roots were there, and when left alone shoots appeared which were no longer cut over for farms or browsed and, more important, were no longer burnt over annually. Consequently, within say a couple of decades (which is as long a period as an official's service in the country usually covers) it seemed as though the forest were advancing out into the desert again.

The true explanation would however appear to be that with man's withdrawal the relics of what he has left continue to produce shoots, and these will persist as long, and only as long, as the roots can remain alive—and for plants we know that this period is not an indefinite one—while each year a deeper layer of sand occupies the area. Examine the countryside between Gao and Tabankort and out into the desert beyond, and you will see the inevitable end of this temporarily rejuvenated green covering. It is this vegetation which is considered to afford evidence of Nature producing a miracle against herself, and bringing back again the aforetime savannah forests on the top of inches of sand; for the mineral soil is many inches below the level which the rootlet of any germinating tree or shrub seed could reach before it dried up. Moreover the spring water-level has now fallen below the point at which it can be of use to man.

This would appear to be a simple explanation of the apparent advance of the vegetation into areas which have been deserted, and it is a very misleading guide upon which to base a belief that all is well with agricultural conditions of the future in North Nigeria, and even more so in the French Colonies beyond. This desiccation in considerable parts of Africa is only a form of erosion. The forester who has studied this erosion question in its various forms is aware that once a certain stage of degradation has been reached there can be no going back: the "dust bowls" of America have driven home that lesson. It is admittedly harder to appreciate the issue in the vicinity of the Sahara with its slow and insidious methods.

Practical investigations carried out in India do not bear out Dr. Falconer's remarks about the water in wells. Why have so many wells, to mention one instance, in the neighbourhood of Timbuktu gone dry within living memory?

Dr. Falconer gives rather an optimistic review of the Anglo-French Forestry Commission's work. It is uncertain how far its findings will be accepted. Mention has been made of research carried out for advancing waves of sand, and of the Damergu crop-sowing experiences. There is another remarkable statement. In French territory it is said that with a few minor exceptions "all the sand is at the present day anchored by trees and grass." What does this mean? The sand is yearly increasing in depth, and when both trees and grass (fired every year and grazed) come to the end of their lives what will there be left?

E. P. STEBBING.

VOYAGES OF MARTIN FROBISHER

THE THREE VOYAGES OF MARTIN FROBISHER IN SEARCH OF a passage to Cathay and India by the north-west, A.D. 1576–8. From the original 1578 text of GEORGE BEST. Edited by VILHJALMUR STEFANSSON, with the collaboration of ELOISE MCCASKILL. *London: The Argonaut Press* (Fifteenth publication. General Editor: N. M. PENZER), 1938. Two volumes. $10\frac{1}{2} \times 7\frac{1}{2}$ *inches*. Vol. I, cxxx+166 *pages*. Vol. II, vi+294 *pages; illustrations and maps*. £4 4*s*

THE general editor, Mr. N. M. Penzer, and the publishers are to be congratulated on the two handsome volumes in which they present afresh the records of a trio of voyages which are of perennial interest, the three voyages of Martin Frobisher in search of the North-west Passage. In choosing an editor for these particular volumes, weight was no doubt given to the fact that the series is intended for the general reader rather than for the specialist in maritime affairs. Dr. Stefansson, as he himself confesses, had no knowledge at all of the early history of Arctic exploration when he wrote his well-known 'Friendly Arctic' in 1921; nevertheless, his personal knowledge of the North, and in particular his intimate acquaintance with the Eskimo, make him an admirable choice. He is able to add liveliness and verisimilitude to the ancient records from which the prelude to Frobisher's actual adventure is built up, and he has many shrewd and illuminating comments to make upon the native peoples whom the explorers encountered. With the help of Miss McCaskill he has brought together a mass of material hitherto widely scattered, and has woven it into an absorbing narrative. The Tudor specialist may complain that he has paid but scanty attention to the Frobisher voyages themselves, and has left untouched such unsolved problems as they still present; the general reader, on the other hand, will delight in having a history of the Arctic in mediaeval times, much of which will be quite new to him.

Starting with Dicuil's notice of the Irish monks in Iceland, Dr. Stefansson takes us through the story of the colonization of Greenland, the discovery of Vinland, and that slow decay of Norse life in the colony which was contemporaneous with the gradual loss of European contacts. It is his belief that the Bristol men who in the fifteenth century trafficked with Iceland were also in touch with Greenland, and that it was the cereals which they carried to the colonists that led to the deficiency diseases which ultimately destroyed them, diseases revealed by the recent exploration of their graves. Furthermore he believes that the account of the extermination by the "Skraelings" of the northern settlement in the fourteenth century was an exaggeration, the white Greenlanders being absorbed by intermarriage. For these opinions however Dr. Stefansson cannot adduce any fresh evidence, and the historian's verdict of "not proven" must still stand. So far as Bristol trade is concerned, such ships as went north were equipped for fishing, for which they were obliged to carry salt in bulk; it is exceedingly unlikely that they would also lade cereals, the export of which from England was moreover strictly controlled. So far as we know, they carried manufactured articles of small bulk into Iceland, and it is not beyond the bounds of possibility that an occasional ship went on to Greenland. That there is something behind the "John Scolvus" story, and that of Pining and Pothorst, the present reviewer is very willing to believe, but no one has yet succeeded in proving that the colonization of Greenland and the Norse discovery of Vinland had any part in shaping the plans of Prince Henry the Navigator, Christopher Columbus, or John Cabot.

So far as Martin Frobisher is concerned there is little point in trying to link him with early Greenland records, for he cannot be regarded as the "rediscoverer of Greenland," since its southern extremity was fairly exactly charted by the Portuguese at the opening of the sixteenth century. Confusion was introduced by the concoction of the partly imaginary, partly authentic Zeni map, in which Frobisher's advisers put complete faith, and confusion was worse confounded by the magnetic variation which reaches a maximum as the magnetic pole is approached, and renders both navigating and charting a difficult matter. The recent researches of Dr. Winter, published in the last number of *Imago Mundi*, afford strong evidence, which is confirmed from other sources, that as early as 1500 the trained Portuguese pilots (who of course were relatively few), could handle the problem of compass variation, and that they deliberately plotted the uncorrected readings on their charts, a quite logical procedure, since they were by definition compass charts. This principle being established, it becomes possible to redraw the old charts, correcting the bearings from point to point so that they become geographically true. The results are surprising, for charted coast-lines that appeared to bear no relation to actuality, take on authentic shapes when treated in the way described. In particular the present reviewer is satisfied that prior to the mid-sixteenth century the Portuguese were familiar with Hudson Strait, and had charted the whole of Ungava Bay.

Turning now to the Frobisher voyages themselves, we must consider the course of events in relation to the character of the leader as it emerges from the story of his early career, a story ably told by Dr. Stefansson and his co-editor. Strong, self-confident, self-willed, untroubled by scruples, Frobisher played for his own hand. It is a curious fact that in spite of a plain statement that steps had been taken to preserve certain secrets, the Frobisher narratives are always taken at their face value. The publisher of Best's account, acting for Sir Christopher Hatton, admits that he tampered with the manuscript, and excised all references to latitude, longitude and the magnetic variation. Dionyse Settle, who went on the second voyage as the representative of the Earl of Cumberland, also omits any indications of location, and is moreover clearly a landsman. The sole first-hand account of the initial voyage, that of ship-master Hall, was not published until thirteen years had elapsed, and although it contains precious observations of the variation as well as of the latitudes of certain landmarks, it appears also to have suffered excision. Working however on a sketch-map, almost certainly furnished by Hall and incorporated in a map drawn by John Dee in 1580 (the detailed evidence will appear in the next issue of *Imago Mundi*), the reviewer has become convinced that the secrets to be concealed were two. The bogus gold-field was the more obvious, the second was the passage to Cathay: Frobisher went well up the Strait on his first voyage, and had therefore good warrant for believing (as Cabot had done before him) that the open water which lay beyond it was the Pacific Ocean. The whole story of the inception of the gold hunt is redolent of fraud. Michael Lok on his own confession, and indeed as the first estimates for the equipment of the second voyage show, was planning to double-cross the leader by sending a ship which would slip away to load ore while the expedition searched for the Passage. For Frobisher, during the early months of 1577, was supposed to know nothing of the report of the rascally Italian alchemist on the stone which he had given to Lok as a souvenir on his first return. He had however quartered himself on Lok, and when at dinner one day he asked if anything had been found in the stone, his query may not have been entirely innocent. His behaviour is consistent with the theory that he planned to set the bulk of the adventurers ore-digging, while

he himself secured the whole glory and profit of the discovery of the route to Cathay. It is significant that when a party of gentlemen, in the course of the second voyage, wished to explore 30 or 40 leagues inland from the south shore of Frobisher Bay, when they would undoubtedly have viewed Hudson Strait from the heights, the leader forbade the excursion, and carried the whole party immediately to the northern side of the Bay. On the third voyage, finding himself, whether by accident or design, in the thinly veiled "Mistaken Straits," he very nearly carried out his design of sailing through and leaving the rest of the party behind. It is to be regretted that Dr. Stefansson did not publish Hall's log of the third voyage, which was transcribed for John Dee, and which contains an account of the ship-master's angry interview with Frobisher on the question of whether they were or were not to the south of Queen Elizabeth Foreland.

On the fascinating subject of the captured Eskimo, too, there is material which the editors have left aside, for so far as manuscripts are concerned, they have gone no further than to reprint from the Hakluyt Society's volume those which were extracted by Admiral Collinson. These dealt specially with the financing and equipment of the voyages, and the accounts of Michael Lok's more personal items of expenditure were not published. It is from the latter that the story of the life and fate of the Eskimo in England can be put together. The first thing done for them was to purchase an outfit of English clothes, which quite possibly hastened their deaths. It is clear that Frobisher had intended to take the first captive back again, and when he died he therefore planned to take his embalmed body instead. The cost of embalming, and of a coffin packed with bran, is given in the accounts, but whether because the embalming was ill performed, or because the sailors refused to have a corpse on board, the man was ultimately buried in the churchyard of St. Olave's, Hart Street, close to the Muscovy House in Seething Lane. That no effort was spared to save his life the charges entered for the apothecary, for linen, and for "folk hired to tend him" bear witness. But those hired to tend the unfortunate man were presently being paid " to wind him," and it was decided to preserve his features on canvas and in wax. A Dutch engraver, William Cure, took the death mask, and made the model, and a young Dutch painter, Cornelius Kettel of Gouda, who was then just beginning to paint in England, was responsible for the several portraits. Whether they were painted before or after the Eskimo's death is not clear. They showed the subject full length, head and shoulders only, in native dress and again in his English clothes. Each picture was duplicated, and apparently Kettel's charge for a full length portrait was £5. One of the larger portraits, that in native dress, was specially framed as a present for the Queen (who never saw the man alive) and Michael Lok himself rode to Hampton Court to present it. Another copy was actually carried to *Meta Incognita* on the second voyage and displayed to the next captive.

The man, woman and child who were brought home on the second voyage were landed at Bristol, and according to the Bristol records the man delighted the citizens by an exhibition, on a backwater, of his skill with his kayak and with his dart in fowl-shooting. He too was put into English dress, and was soon seriously ill with pneumonia. The report of Dr. Dodding who conducted the post-mortem is unfortunately left by the editors in the original Latin; the story of how the man raised his voice in a swan-song in his moment of death is a pathetic one. The woman had already some sickness upon her, seemingly measles or chicken-pox, but the doctor, determined to prove to her that his countrymen were not cannibals (as the Eskimo firmly believed), insisted, in spite of her unwillingness, that she should be present at the man's burial. The funeral

was deliberately robbed of all ceremony lest she should believe it a sacrifice, and it seems likely therefore that the man had been baptised, for otherwise there could have been no question of ceremony. The wretched woman was also shown bones from neighbouring graves, so that she might understand what the English practice was. She did not long survive, and since the Queen had again been thwarted of her wish to see living Eskimo, a nurse was procured for the child, then about eighteen months old, and it was taken up to London. The journey took eight days, and after three days' lodging at the *Three Swans*, the babe too was dead, and Michael Lok was at the expense of sending the nurse back to Bristol. The last relevant entry records the child's burial, beside the first Eskimo man in St. Olave's churchyard, but a search of the Parish Registers has recorded no entry for these strangers.

The story does not quite end here. Cornelius Kettel had been commissioned to paint the woman and her child at Bristol, and their framed portrait in native dress was presented to Queen Elizabeth as a New Year's gift. Thomas Platters, the German traveller, saw it at Hampton Court in 1599 hanging beside the man's portrait. Over the woman was written *Gutiac*, and over the child *Nutiac:* these were believed to be their names, as learned from the second man, but as Dr. Stefansson's vocabulary of Eskimo words informs us, they mean simply "woman" and "child." Dr. Dodding was shocked because this woman betrayed no visible sign of grief at the death of her fellow-countryman: was she really insensible, or was she not rather stunned by the incredible change that had befallen her? A careful inquiry has failed to reveal the present whereabouts of any of Kettel's portraits, save that of Frobisher himself, for he painted also the English leaders of the expeditions, and the ships. Nor is it likely that the kayak has survived, last seen, as it would appear, by the same Thomas Platters in the collection of rareties gathered by Walter Cope, and earlier examined by Richard Hakluyt, in London. E. G. R. T.

REVIEWS

EUROPE

THE MIDDLE LEVEL OF THE FENS AND ITS RECLAMATION. By H. C. DARBY, with . . . PHYLLIS M. RAMSDEN. With MAPS OF THE FENLAND. By EDWARD LYNAM. (Reprinted from 'The Victoria History of the Counties of England. Huntingdon III.') Published for the University of London Institute of Historical Research. [*London*]: *The Saint Catherine Press*, 1936. $12\frac{1}{2} \times 8\frac{1}{2}$ *inches; 249–306 pages; illustrations and maps.* 15*s*

The English Fenland lends itself particularly well to treatment in a monograph like the present, for its exceptional physical character has had a marked influence on its history, economic and social, and Dr. Darby's exhaustive study of the old records, monastic and other, has qualified him well for such a study. His results as to the earlier period were briefly described in the *Journal* for November 1932.

The present study forms part of the Huntingdonshire volume of the County Histories, and as not even the Middle Level of the Fens (specially referred to in the title) lies wholly in that county, the subject is necessarily treated from a more general point of view, which adds to its value for many readers. Dr. Darby brings out clearly the main trends of social and economic change through the centuries, the most marked having been due to the dissolution of the monasteries—overlords in early times of most of the land capable of utilization. The main economy of the district then rested on the pasturing of cattle, supplemented by fishing, wild fowl taking, etc. In the fishing, eels took an important place, and actually formed a kind of currency. With the passing of the monasteries no one was left with resources enough to protect the firm lands from flooding, and the idea of a more general reclamation met with opposition from vested interests, though supported in some quarters. The way was thus open for the coming of outside "Adventurers," led by the hope of profit from reclamation on a large scale.

Dr. Darby deals succinctly with the chequered fortunes of the various attempts at drainage which followed, and supplies an outline map showing the many different "cuts"—particularly of course the Old and New Bedford rivers—carried out by the Bedford Level Corporation and its successors. Many hindrances were due to the conflicting interests of navigation and drainage, while some of the schemes were mutually antagonistic, evil results accruing from the want of a strong central authority. Thus when the fall of the surface proved insufficient to carry off the water, and recourse was had to windmills, the gain of one area often became the loss of another. The greatest difficulty, due to the sinking of the surface with the loss of moisture, has been only partially solved by the modern introduction of pumping by steam.

The author has found such abundant material in the MS. or printed records that he does not seem to have had recourse to old maps to any great extent. In fact, his one reference to an early map (that of Hayward, 1604) is not strictly correct. Possibly he has intentionally left this part of the subject to Mr. Lynam, whose careful and well-arranged catalogue of the most important maps of the Fens forms the latter part of the reprint. Mr. Lynam has been able to correct and amplify Sir G. Fordham's list in many directions, particularly with regard to Hayward's lost map of 1604 (see *Geogr. J.* 84 (1934) 420; 85 (1935) 111), and its contemporary and later copies. He has wisely restricted himself mainly to maps of some original value, many of them in MS., preserved at the British

Museum, the Fen Office at Ely, the Public Record Office, and elsewhere. No claim is made for completeness, even from this point of view, and one of the happy results of such a study is that it may help to bring to light maps not generally known. One such appears to be a large-scale map hidden away in a collected volume in the Society's map-room, devoted mainly to Lincolnshire, but embracing fen areas in neighbouring counties. The map embodies the survey of Sutton and Mepal Levels in 1750 by William Elstobb, Jun., and as it is dedicated to Robert Montague, Duke of Manchester, who died in 1762, it must have been printed before that year. It covers seven parishes only, but these form an important part of the Middle Level. The map is printed on six sheets, on a scale of about 8 inches to the mile. The collection includes a good many of Mr. Lynam's items, one being Sir Jonas Moore's large map in sixteen sheets (as issued by Christopher Browne about 1706), apparently in better condition than the Museum copy, a portion of which is reproduced with the Memoir. This also gives pictures of windmills and other old methods of raising water. E. H.

THE GREEN HILLS OF ENGLAND. By R. A. J. WALLING. *London: Blackie & Son*, 1937. 8×5½ *inches;* x+306 *pages; illustrations and sketch-maps.* 7*s* 6*d*

This is a collection of personal reminiscences of happy holidays spent among the hills of southern England. The area covered is bounded by the sides of a triangle of which the vertices are roughly Shrewsbury, Exeter, and the North Foreland. The Chilterns are (rather surprisingly) excluded; it is asserted on the dust-wrapper however that Mr. Walling has "wandered over" them also.

The book has little to recommend it. The author, who thinks that within the circle of Avebury "nearly the whole" of the village is built and who has failed to find the substantial remains of Abingdon abbey that lie to the south-east of St. Nicholas' church, cannot be accounted a very observant traveller. He tends moreover to be very positive about the highly controversial and complacently to accept the unverified. He states for instance that the tradition that the old hill road from Winchester to Canterbury was used by the pilgrims to Becket's shrine "is well founded." As a matter of fact the tradition is not supported by a shred of evidence. There are other examples of this tendency. The monument on Cherhill Down commemorates not Edward VII but Sir William Petty. White Sheet Hill, near Shaftesbury, is not the highest hill in Wiltshire by some 200 feet. The Sussex river Adur first appears *eo nomine* in the 'Polyolbion' (1612); the name therefore cannot "remain to us from British times."

In his introduction Mr. Walling disclaims any "special knowledge" and perhaps would think that such errors should be condoned. It will readily be acknowledged that a book of this kind is not intended to be a work of science. But even pipe-and-slippers topographers should realize that they require a larger equipment than enthusiasm and a guide-book. R. B. P.

COTSWOLD DAYS. By COLIN HOWARD. *London: Blackie & Son*, 1937. 8×5½ *inches;* 278 *pages; illustrations* (by CLIFFORD WEBB). 8*s* 6*d*

Country lovers will be grateful to Mr. Howard for this chronicle, in which he sets before us his Cotswold year from the January snows to Christmastide. He is not content merely to show us the world from his cottage window, but takes us abroad to such well-known scenes as the Newent daffodil fields and the Severn bore, or Barton Fair at Gloucester, and the cheese rolling at Cooper's Hill. Although his taste is catholic, he does not rely mainly on incidents with news value for his matter. We are taught how to identify birds by their individual

songs and flight, and country lore about the kind of log which burns most cheerfully on the winter fire. Interspersed are his musings on life and men. He unites a lively insight into the Cotswold character and a mastery of the dialect with a vigorous prose style. The sketches of village life are the most vivid and satisfying parts of the book; the scenic descriptions are less happy. Many of the similes are incongruous and over-elaborated, and the writing is spoiled by a fondness for archaisms. But these mannerisms can be forgiven in gratitude for the amusing anecdotes and delightful pen-portraits of Cotswold men, and for the gleanings from rustic wisdom. The chapter-heads are pleasantly decorated with wood-cuts by Mr. Clifford Webb. C. E. K. S.

FRANCE: a geographical introduction. By E. ESTYN EVANS. *London: Christophers*, 1937. 8×5 *inches;* xvi+184 *pages; illustrations and maps.* 4*s* 6*d*

Although some might think that the author's claim to have "traced the evolution of nature and human society in nature's setting," in the space of some forty pages, is a little bold, it cannot be denied that Mr. Evans has greatly enriched the condensed account of the geography of France by several helpful and suggestive chapters dealing with the anthropology and history of the country. He sketches the early settlement of France, the gradual spread of civilization, and the various stages in the evolution of the French nation. "The centralized kingdom of France emerged in the long run as the first centralized kingdom of Europe with a continuous development into modern times." This might have been better worded, but the idea is interesting. Some of the author's generalizations need a little clarification:—"a remarkable capacity to absorb external influences" will hardly apply to France to-day, unless some subtle meaning be given to the word "absorb" (p. 7). Again (p. 17) the author presumably does not mean that the Romans set out to demonstrate, by constructing roads, that nature had fitted France to mediate between the Mediterranean and the Ocean, though that is what his words imply; and it is not clear what he does mean. But these are minor blemishes in a very attractive little book. The maps are admirably clear, though the use of the 600-foot contour line is not suitable in all of them; indeed in Fig. 16 it is frankly misleading, while the use of the 300- to 1000-foot interval in Fig. 19 needs some justification. The photographs are well chosen. Teachers in the upper forms of schools should find this book extremely useful. H. O.

MOUNTAIN DAYS IN THE HIGHLANDS AND ALPS. By J. HUBERT WALKER. *London: Edward Arnold & Co.*, 1937. 9×6 *inches;* 320 *pages; illustrations and maps.* 16*s*

This book is a record of walks and climbs in Scotland, in the western Alps, and in Tyrol. It is written in an easy and pleasant style, describing both the countryside and its inhabitants. The author has no stirring adventures to record, but he has the gift of communicating his own enjoyment of scenery to his readers, and the fact that the expeditions here described are mostly within the reach of the modest traveller with little mountain experience will make its appeal the greater. The book is well arranged, leading gradually from walks to more ambitious expeditions, and is throughout well illustrated, though the reproduction of photographs varies in merit.

The first section dealing with Scotland contains a long and clearly written chapter concerning the Appin Murder, which might have been put more shortly, as it breaks the author's narrative of progress from stage to stage in mountain walking. Again, the story is interrupted at times by political discourses and lectures in physical geography, which belong rather to the classroom than to

the holiday spirit characteristic of the book; nor is the author at his best when describing the rock climb on Stob Dearg, where he lapses into a style and humour of a type now defunct in climbing literature. Apart from these criticisms, the book deserves commendation; the author has read widely in mountain books, and has clearly understood the spirit which has led mankind to a fuller understanding of the mountain world. H. E. G. T.

LA BRETAGNE. By RENÉ MUSSET. (Collection Armand Colin. No. 205.) *Paris: Armand Colin*, 1937. 7×4½ *inches;* 216 *pages; maps and plans.* 15 *fr.*

M. Musset's little book summarizes clearly and concisely the geographical basis of the landscape of Brittany and the life of the Bretons. Brittany, isolated by sea and by land, is yet bound closely by cultural and economic interests to France, and these bonds are continually strengthening. Though 60 per cent. of the population are agriculturalists, it is as sailors that the Bretons have served their country, and this has resulted as much from historical as from geographical causes. Visitors to Brittany cannot fail to be struck by the characteristic features of the countryside; if they wish to understand these, they will find enlightenment in this vital sketch, which however will be found equally of value to more serious students. G. R. C.

TO MEET THE SPRING: a book of travel and discussion. By BASIL COLLIER. *London: J. M. Dent and Sons*, 1937. 8½×5½ *inches;* viii+296 *pages; illustrations and sketch-map.* 10*s* 6*d*

This is the story of a simple journey from the Spanish to the Italian frontier along the French Mediterranean coast. While the itinerary was hardly novel and the methods of transport were ordinary, the author's refreshing criticisms on his contacts with men and things combine to make his book as interesting as it is delightful. Erudition is not lacking, but sympathetically applied, and it is interesting to speculate with Mr. Collier on what might have happened had Constantine selected Arles for his capital instead of Byzantium. It is fitting, too, to find Les Baux associated with Dante's *Inferno*. But was it the Val d'Enfer that suggested the décor to Dante, and not the Slavini di Marco landslide near Verona?

Occasionally Mr. Collier takes pleasure in displaying a slight perverseness, as when he despises easy chairs, or insists on the reality of the *tarasque*, or wants Switzerland without the Swiss. But the reader will forgive him this and more in return for the intense pleasure which his pen-pictures give. G. R. de B.

RUSSIAN MEDIAEVAL ARCHITECTURE, with an account of the Transcaucasian styles and their influences in the West. By DAVID RODEN BUXTON. *Cambridge: University Press*, 1934. 10×7½ *inches;* xii+112+108 (*plates*) *pages.* 25*s*

For geographical and historical reasons architecture in Russia has developed along lines of its own, and for historical reasons it does not show the continuity to which the gradual merging of styles in the West has accustomed us. Those who desire to obtain some grasp of the principles underlying Russian architecture will be grateful to Mr. Buxton for the simple manner of his description of them. He traces the early developments along Byzantine lines in Kiev, Vladimir, Novgorod (where the "onion" dome first appeared in the twelfth century), and Pskov: the earliest settlements lying on the trade routes from the Black Sea to the Baltic. When, after the Mongol invasions, Moscow became the centre of independence and orthodoxy, the "tent-roofed" church based on the wooden buildings of the north for a time supplanted the Byzantine type, until forbidden by edict in 1650. The author then deals with the influence of the Ukraine

(which was united to Russia in 1654) on the planning and decoration of the seventeenth-century Baroque: an influence cut short by an edict in 1714 forbidding building in stone outside St. Petersburg. The last third of the book is devoted to the architecture of Armenia and Georgia, and the vexed question of its origins and influence. In the Rivoira-Strzygowski dispute Mr. Buxton is impartial, and there is an excellent bibliography indicating further sources of information. The plates are well chosen and reproduced; and, though constant reference is made to them in the text, they are furnished with lengthy explanatory captions. J. P. H. M.

ASIA

FORSCHUNGEN IN INNERANATOLIEN. By HERMANN WENZEL. I. Aufbau und Formen der Lykaonischen Steppe. vi+48 *pages*. II. Die Steppe als Lebensraum. 8+144 *pages*. (Schriften des Geographischen Instituts der Universität Kiel. Band V, Heft 1, and Band VII, Heft 3.) *Kiel:* 1935 and 1937. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches; illustrations and maps*. *M.*3; *M.* 8

Herr Wenzel has made a close study of north-west Lycaonia, where he has carried out researches in recent years. In 'Forschungen in Inneranatolien I,' published in 1935, he described the geological and geographical features of the Lycaonian steppe lands. The only other fairly complete description of the region would appear to be by Tchihatchef, whom he claims to have outstripped: "The observations of Hamilton, Naumann, and Frech only relate to border-regions. Philippson's researches in Western Asia Minor are more important. . . . Although they do not embrace the steppe lands of inner Anatolia, they have nevertheless shed light on the conditions existing there." It is interesting to note that Herr Wenzel considers the appellation "Lycaonian Salt Desert," used in Stieler's Atlas to denote the region, to be incorrectly applied to "dry steppes with patches of salt steppe interspersed." The main object of the author's researches was not however to collect data which would enable him to make a description of the geological and geographical characteristics of the parts in which he travelled. The task which he set himself was to study, in conjunction with climatic conditions, the various kinds of settlements and farming in vogue among the different ethnographical groups; and in Part II (1937) he gives much useful information about the climate, hydrology, and soil of west Lycaonia and describes the existing villages, the mode of living of the inhabitants, and their methods of irrigating and cultivating the fields. In an historical survey, containing some interesting statistics, he endeavours to account for periods of prosperity like that of the first centuries of the Christian era, or of depopulation like that which began in the seventh century. He lays special emphasis on the fact that climatic changes have not been responsible to the extent once generally accepted. Nevertheless climate remains an important factor which must be taken into account by those who are elaborating schemes for the development of agriculture in inner Anatolia, and the author examines climatic conditions at some length, giving some interesting meteorological figures. The amount of rainfall is very small, and the hydrology of the region is such that there is a considerable shortage of water for irrigation. Herr Wenzel suggests means of solving, at least in part, this very grave problem. He states that at present the water is brought to the fields in open ditches, where much of it is lost by evaporation, and he also points out that legislation is required to regulate the amount that may be used for various purposes. So-called "dry farming" would, he thinks, give the best results.

The development of agriculture as the backbone of Turkish political economy

is an important item in the programme of the new régime. Although, judged by European standards, much may still appear to be very primitive, considerable progress has been made in a comparatively short space of time: "The effects of the present development are also surprisingly marked in the Central Anatolian steppe lands. The number of nomad herdsmen has been reduced to such an extent that they are now a negligible quantity. The old-established population and the immigrants have increased the number of settlements. Corn-growing and the cultivation of the more valuable kinds of fruits have increased, replacing cattle-breeding." In the author's opinion, it might be wise to put a limit to this development in the steppe lands: "One may wonder whether, at this juncture, it is expedient to carry the development any further than is absolutely necessary for the requirements of the existing population. At present, Turkey still has, in the eastern portion of the country, extensive thinly populated areas which will have to be filled with peasantry . . . she is able to grow all the produce of the temperate and sub-tropical zones and does not need to impose on any region a development that stands in contradiction to natural conditions."

The maps are interesting and the bibliography is excellent. F. M. M.

'IRAQ: a study in political development. By PHILIP WILLARD IRELAND. *London: Jonathan Cape*, 1937. 8×5½ *inches;* 510 *pages; maps and portraits.* 15*s*

This book is aptly sub-titled "A study in political development," and it is certainly an exhaustive and interesting one. The immense value of Sir Percy Cox's work is well described. The problems of administration are traced from the ratification by the Constitutional Assembly of the Treaty of 1922 to the entrance of 'Iraq into the League of Nations in 1932. Though a responsible Cabinet was presumed to exist after the first elections Ministries vanished because King Feisal wished them to disappear. No less than fifteen cabinets faded away between 1921 and 1933. The result was that Premiers only chose Ministers whom they thought would be agreeable to the King. It was the endeavour of King Ghazi to follow in Feisal's footsteps, but more constitutional methods have obtained during his reign, though the Chamber of Deputies does not appear to have taken its full share in the government of the country. The author however comes to the conclusion that Parliament has fulfilled a useful function in the development of 'Iraq. The present form of government could not be expected to attain its full development overnight: a satisfactory administrative service is a plant of slow growth. The book is of importance to students of government, but the geographical interest is not great, nor is it intended to be anything but a study of the development of the country's government. The maps of the Persian Gulf, Basra and the surrounding country, and 'Iraq are adequate for the purpose of the book. H. StC. S.

INDIA: a short cultural history. By H. G. RAWLINSON. (The Cresset Historical Series. Edited by C. G. SELIGMAN.) *London: The Cresset Press*, 1937. 10×6 *inches;* xiv+452 *pages; illustrations and maps.* 30*s*

In view of the diverse ethnic constituents of the population and the endless and ever-changing political divisions into which the sub-continent was divided prior to the British hegemony, the task of compiling a consecutive history of India as a whole is wellnigh impossible. Mr. Rawlinson has not attempted this. He deals with the salient features of the country's history from Vedic times down to the nineteenth century, with a brief chapter on "Modern India." The more striking incidents and characters of the various epochs and empires are portrayed; the different religious movements, periods of outstanding activity

in literature and the arts; and the contacts with the West, with the Archipelago, Indonesia, and the Far East, have been briefly and skilfully described. Though the greater part of the text treats of history in the general sense of the word, it may be said to have a cultural background: the plates, which are well produced, and the illustrations are almost all representative of different periods of sculptural and architectural output. The volume is doubtless intended for popular reading, for which Mr. Rawlinson's facile and attractive style makes it suitable. The serious student of things Indian however will find many details open to criticism. For readers of this *Journal* it must suffice to refer to a few geographical points. Mount Aornos, as now identified by Sir Aurel Stein, does not lie at the junction of the Kabul and Indus rivers (p. 57), but more than 70 miles (in a straight line) north-north-east of this. It is not likely that Alexander crossed the Hala (Kirthar) range (p. 62); he probably went round the southern end of it (see also the map on p. 56). At any rate his troops suffered most in passing through arid Gedrosia (Makran); and the mileage of the march from the Indus to Susa must have been nearer 1500 than 500. Inscriptions of Asoka have been found at five sites farther south than Maski (p. 75). Nasik cannot be described as at the source of the Godavari (p. 155), which is near Trimbak. Babur's battle by the banks of the Gogra took place in what is now a portion of the Ballia district, U.P., a long way from Patna (p. 290). Some eight of the sites marked on the map on p. 146 have been inaccurately placed. Konarak lies north-east of Puri, and not south-west of that town by the southern end of the Chilka Lake, as shown on p. 177. Delhi is situated on the west bank of the Jumna, and not on the east bank, as shown on pp. 199, 248, and 376. C. E. A. W. O.

THE LAND OF THE GURKHAS, or the Himalayan Kingdom of Nepal. By Major W. Brook Northey; with a chapter by Brigadier-General the Hon. C. G. Bruce. *Cambridge: W. Heffer & Sons*, [1937]. 9×6 *inches; x+248 pages; illustrations and map.* 10*s* 6*d*

Nepal is a fascinating country and has long needed a handbook describing its beauties and its interest in a compendious form, and with such a volume Major Northey has now provided us. He is fully qualified for his task. In addition to twenty years' service in a Gurkha battalion he has acted as Gurkha recruiting officer, and has visited not only the capital, Kathmandu and the Terai, but has been allowed access to districts hitherto unknown to and unvisited by any European; and we know him also as the joint author, with Captain C. J. Morris, of an excellent handbook on "The Gurkhas." In this book he gives us a complete view of Nepal—its geography, history, ethnology, with chapters on the customs and characteristics of the various tribes, the temples and shrines, and the three cities of the central valley, Kathmandu, Patan, and Bhatgaon.

Nepalese history dates back for many centuries, but lack of adequate records makes accuracy and precision impossible. The earliest monuments to which even an approximate date can be assigned are the four "stupas" erected by the Buddhist Emperor, Asoka, in the third century B.C., but it is known that a highly civilized state must have existed in the valley long before that. Thence we see the rise and fall of many kingdoms and dynasties, culminating in the final conquest of the whole of what is now known as Nepal by the ancestor of the present Royal House. This is a comparatively recent event, as it was only in the year 1769 that Prithwi Narayan finally subjugated the last of the three small rulers who divided the central valley between them, and was able from that base to extend his authority. The conquest was followed by troublous years, and we see Nepal involved in wars with Tibet, China, and finally with the East India Company, and convulsed by serious internal disturbances. But

from these latter arose the remarkable system of government which now prevails, that of an omnipotent Prime Minister with the King as a semi-sacred figure in the background.

Among the most interesting chapters in the book are those wherein the author describes the rise of the dynasty founded by the great Jung Bahadur—a figure of legendary courage and ability—and its continuation by worthy successors to the present day. Under these rulers Nepal has advanced and prospered internally, and has proved a staunch friend to England. We learn how Jung Bahadur came to help us at the time of the Mutiny at the head of his troops, and how his nephew and successor, Sir Chandra Shum Shere Jung, stood by us during the Great War. And it is satisfactory to learn that the present Prime Minister, Sir Joodha, has carried on the traditions of his family both in the internal administration of the country and in his foreign policy.

Major Northey's knowledge of the Gurkhas and their language enables him to give us an intimate picture of these brave little soldiers, and he helps us to realize the value to the Indian Army of 20,000 such men.

A preliminary chapter by Brigadier-General the Hon. C. G. Bruce deals exhaustively with the geographical divisions of Nepal, and he shows how the great Himalayan ranges and their outlying spurs have influenced the distribution of the tribes and determined their main centres of population.

The book is profusely illustrated by photographs and includes a good map of the country. F. O'C.

SOCIAL AND PHYSICAL ANTHROPOLOGY OF THE NĀYĀDIS of Malabar. By A. AIYAPPAN. (Bull. Madras Government Museum. N.S. General section. Vol. II, No. 4.) *Madras: Government Press*, 1937. 11 × 8½ *inches;* iv, 142 + xii (*plates*); *illustrations and map*. *Rs.*3-2-0

The Nāyādis, who number not more than 600 souls, live along the border line between British Malabar and Cochin State. In Malabar opinion they are the foulest of all untouchables; by the rules of "atmospheric pollution" they may not go within 74 feet of a Brahman, and they even pollute other untouchables. It is not easy for them to cross a road, let alone a bridge. Formerly they were hunters ("Nāyādi" means "hunter," not "dog-eater," as some unkindly aver); now they beg, and each family has its own begging preserve on which other families may not poach, though the right to reserve can be sold or mortgaged. They usually beg in gangs; they stand well away from the houses of their patrons, or from the roadside, and howl for alms.

Unlike earlier ethnographers, Dr. Aiyappan appreciates the value of geographical precision. A map of Nāyādi settlements shows how the expansion of cultivation from the West robbed them of their hunting ground and set them adrift. Geography also accounts for differences in clan organization, in the gods worshipped and their festivals, in wedding and funeral rites. Attention to the provenance of his evidence saves Dr. Aiyappan from the pitfalls of faulty generalization into which others have tripped, and enhances the scientific value of his work. In no two of the three southern taluks of Malabar is Nāyādi culture exactly the same; in each area it is conditioned by the environment, physical and social.

Of elements common to the whole caste, the most notable are a firm belief in immortality (but not reincarnation), the sacred space (*mannu*) in which stones are set up to represent the dead and are worshipped with the gods, and the cult of a supreme god of the hills. The last two have analogies among the tribes of Chota Nagpur.

From the anthropometric data laboriously collected and the conflicting

reports of previous observers no certain inference can be drawn. The uplift of a folk so few and feeble is not easy; Muslim, Hindu, and Christian philanthropists have tried and failed, the Governments of Madras and Cochin have now taken up the task. It is no light matter for a Nāyādi to break with his kinsmen and ancestors and brave the snubs of labourers of slightly higher status. Moreover, as a source of livelihood begging is less precarious than work. Dr. Aiyappan's plates are well chosen and facing each is printed a descriptive note. His English is easy reading, and in every way this monograph does credit to him, to the Museum Bulletins and the Madras Government.

There are a few slips. An ear-ring can hardly be "21 inches in diameter" (p. 89). Welsh's 'Military reminiscences' was published in 1830, not 1730 (p. 10). The western equivalents of certain Malabar month names are wrong (pp. 54, 71). F. J. R.

AFRICA

IL SÀHARA ITALIANO. Parte prima: Fezzán e oasi di Gat. *Roma: Reale Società Geografica Italiana.* Anno XV [1937 A.D.?]. 10×7 *inches;* 724 *pages; illustrations and maps.* L50

This is a handbook published under the auspices of the Italian Royal Geographical Society in the form of a symposium of short monographs on a variety of different subjects and of varying value. The geological and climatological surveys are painstaking and thorough, though the latter may require some modification when observations over a longer period are available; the same may be said for the study of the flora. The zoological section is a mere catalogue which the author himself admits is not comprehensive.

In the chapters dedicated to prehistory, history, and archaeology the standard set by the earlier contributions falls off. It would in any case hardly have been possible for the contributors to have dealt adequately with these topics in the space to which they were presumably restricted. The shortcomings of these sections are to a great extent compensated by the admirable bibliography quoted by the authors.

The anthropological and ethnological sections are flimsy, but the demographic and sanitary reports contain meticulous statistical analyses. The contribution on languages is neither well informed nor informative.

There are in addition a survey of economic potentialities, a Baedeker of the oases, and notes on communications, cartography, and the administrative organization.

The map (in pocket) is 1/M and there is besides a geological sketch-map. The index is good. P. R. R.

THE BIRDS OF BRITISH SOMALILAND AND THE GULF OF ADEN. By Sir GEOFFREY ARCHER and EVA M. GODMAN. *London: Gurney and Jackson,* 1937. Two volumes. 11×8 *inches;* xcvi+286 *pages;* viii+290–626 *pages; illustrations and maps.* £3 3s

Although primarily a history of the birds, in which their life histories and nidification are dealt with very fully, these volumes contain much both for the historian and for the geographer. In the taxonomic side of their work the two authors have drawn copiously upon the knowledge of the professional ornithologists in the British Museum (Natural History), and of Professor Oscar Neumann of Berlin, whose practical assistance is acknowledged in the Prologue. Where the views of the experts differ, the authors are careful to quote both sides. The taxonomic "keys" to the species, though not entirely original, form a valuable part of the book. Sir Geoffrey writes with ease, and both

in his account of the natural features of Somaliland and when dealing with the main theme of his book, he brings a vivid picture to the reader's mind. In the "Historical note," with which he prefaces volume I, Sir Geoffrey has much to say about the "Mad Mullah," Seyyid Muhammad Abdullah, a Somali fanatic who from his rise in 1895 was to harry and devastate the country at intervals for twenty years. There follows a brief ornithological history of Southern Arabia, the Gulf of Aden, and British Somaliland, and the reader is reminded that as long ago as 1854 Sir Richard Burton entered Somaliland by way of Zeila disguised as an Arab, and explored as far as Harar. In the Introduction the general reader will find a well-written, comprehensive account of the country, embellished with some excellent photographs. Of the Somalis themselves Sir Geoffrey writes with sympathy and understanding. He deals with Somaliland from every angle of its physical aspect, its people, its climate, its botany and with the evolution of its birds. The account of the life history of the various species reveals him as a first-rate observer and writer who, incidentally but very effectively, paints a picture of the country and of life as it is lived there to-day. Both he and Miss Godman (the latter being mainly responsible for the descriptions and systematic part of the volumes) have obviously read widely in their subject and quote from many sources. Facing p. xcvi is a useful sketch-map, the explanation of which, printed on p. xxxii, would have better appeared on, or facing, the map. At the end of volume II is an excellent layered map of "Ethiopia and adjoining territories" on a scale of 1/4 M. There is an ingenious "Bird-nester's calendar," a bibliography of ornithological works consulted, and a carefully compiled index in each volume. Of the sixteen coloured plates of birds by the late Archibald Thorburn (the last pictures he ever painted) no praise can be too high, though the originals have, it is feared, lost something in reproduction. Four coloured plates of eggs by Henrik Grönvold fully maintain that artist's high reputation. Both volumes do the greatest credit to the printers.

Both Sir Geoffrey Archer and Miss Eva Godman are to be congratulated on the completion of the first two volumes. It may be said without fear of contradiction that the completed task will be the standard work on Somaliland ornithology for many years to come. D. A. B.

THE GOLD COAST, YESTERDAY AND TO-DAY. By PAUL REDMAYNE. *London: Chatto and Windus*, 1938. 10×7½ *inches; 128 pages; illustrations and sketch-map.* 10*s* 6*d*

The feature of Mr. Redmayne's book is the number of excellent photographs of Gold Coast scenes and daily life, taken during a recent business tour. The pictures of the European castles, of the annual yam festival, and of the work at Achimota College typify the main strands of Gold Coast history. The blending of old and new is well brought out. The text is a simple commentary upon the illustrations, the development of indirect rule, and the emergence of the present community of settled agriculturalists. The book will be useful in schools for its presentation of modern life on the coast, and students of West African history will find the photographs of the castles interesting. G. R. C.

MINING AND METALLURGY IN NEGRO AFRICA. By WALTER CLINE. (General series in anthropology. Edited by LESLIE SPIER. No. 5.) *Menasha, Wisconsin: George Banta Publishing Co.*, 1937. 10½×8 *inches; 156 pages; illustrations and maps*

This is one of the most important works concerned with the cultures of African peoples that has appeared during the last decade. It is remarkably comprehensive, assembling all the data on mining and metallurgy which are con-

tained in the very extensive ethnological literature on negro Africa. The attention to geography throughout is very gratifying, and the book stakes a claim for an honoured place on our library shelves. The only criticism concerns the format, which is unsatisfactory in that it makes reading very difficult. Double columns of small, badly spaced typescript are a trial to the eyes.

The author indicates quite early that gold, which has lured so many modern prospectors to Africa, was regarded very lightly by the negroes until European penetration of the continent. On the other hand iron working is of venerable antiquity in many parts of Africa and, indeed, is so widespread a craft that the only communities which know nothing of it are the pygmies, the bushmen, and the inhabitants of Fernando Po. As iron ore usually occurs near the surface, galleries and shafts are often unnecessary, so that ancient mining has left but little trace. Iron and iron slag which have been found in the earliest deposits at Zimbabwe give us a minimum dating of about the eighth century A.D., for the beginning of iron-working in the south-east of Africa. The Congo Basin, where migrations of culture have been utterly confusing in their complexity, is characterized by the most varied metallurgical histories of any region of Africa; iron working has only recently reached certain of its peoples, whilst others have mined and fashioned iron from comparatively early times. The first of the negroes to smelt iron were those of the western Sudan who, about 400 A.D., came into contact with camel-men penetrating southwards from the Sahara and bringing a knowledge of Mediterranean arts and crafts with them. Egypt, rather surprisingly, has been of little importance throughout the long history of metallurgy in Africa. The knowledge of smelting spread rapidly eastwards over the Sudanese grasslands, but penetrated the Guinea forests with difficulty and then at only a few points. The Congo Basin and Rhodesia acquired iron smelting from this culture spread, though the natives of the south-east coast of Africa first learned of iron from Arab or Indian traders round about 600 A.D.

The copper of Katanga supplied native smiths over an immense area, for it was traded to the east coast and to the Arabs, while westwards it penetrated to the Atlantic coast. It is supposed even that bronze made in Ashanti contained copper from Katanga. Curiously enough no negro culture has been known to show real proficiency in the manufacturing of bronze, and very rarely does the native-worked alloy contain tin and copper in the standard ratio of one to nine.

W. F.

NORTH AMERICA

THE CARTOGRAPHY OF THE NORTHWEST COAST OF AMERICA to the year 1800. By HENRY R. WAGNER. *Berkeley: University of California Press* (*London: Cambridge University Press*), 1937. Two volumes. $12\frac{1}{2} \times 9$ *inches;* vol. I, xii+270 *pages; facsimile maps.* Vol. II, vi+271–543 *pages.* £4 10*s*

Mr. Wagner needs no introduction to students of the exploration of north-west America, and this review must needs concern itself rather with method and arrangement than with the details of the story. The plan is logical and well balanced, with full apparatus for reference from one section to another, for which no doubt we have to thank, in part at least, Mr. Wagner's collaborator, Mr. Charles L. Stewart. The author's own researches have however been the solid basis and, besides examining a host of published maps, some very little known, he has been untiring in his search for original documents in many important libraries. He has also had access to the remarkable collection of photographs of old maps brought together by Professor Karpinsky, a selection of which is in the Society's Map Room.

A general outline of the subject is given in a series of chapters in vol. I, where the story of exploration is reviewed step by step and the relation thereto of the most important maps clearly brought out, as well as the mutual relations of the maps themselves. On the side of exploration Spanish work naturally looms large, embracing the early efforts of Coronado, Vizcaino, and others, and, after a considerable interval, the renewed advance in the eighteenth century by Perez, Heceta, and many more, down to the voyage of Galiano and Valdez almost at the end of the period. Other nations took part through the great expeditions of La Pérouse, Cook, Malaspina, and Vancouver, as well as through the less spectacular work of the Russians in the Far North and the British fur-traders in the Nootka region. At intervals, especially when exploration was at a standstill, Mr. Wagner deals with important periods of general cartography, some yielding purely fantastic results as regards the field in question. Care is taken to define special types of maps, such as those in which California appears as an island, a type inaugurated by Henry Briggs in 1622. More technical matters, such as the varying longitudes assigned to the coasts in question by different map-makers, are not shirked, and Mr. Wagner even discusses the attempts to improve the basis of the world-map from this point of view made by the Italian Jesuit Riccioli in the seventeenth century, though trustworthy data for north-west America were then almost wholly lacking.

But the most valuable parts are no doubt those treating of the less-known Spanish voyages and the original maps resulting from them. This volume is illustrated by forty reproductions of old maps, both of explorers and professional geographers, and the only cause for regret is that the thin and semi-transparent paper used for the folding maps (with a view, we suppose, to reducing the bulk of the volume) does not conduce to great clearness.

In vol. II we have first a descriptive catalogue of over 900 maps, in chronological order. Even this large number implies no attempt to be exhaustive, the main attention being given, wisely, to such maps as played some definite part in the evolution of north-west American cartography. The exercise of a still more rigid selection might perhaps have been an advantage. The pedigrees, so to speak, of the various maps, and their mutual relationships, are well brought out. Even general world maps are critically studied with reference to this part of the world: thus Mr. Wagner finds details in the big Hondius map of 1608 not given in the same author's atlas maps. Notes are supplied on the size, content, and present locale of each important map, with references to existing descriptions and reproductions. Here the drastic system of abbreviations necessitates a rather frequent reference to the key, and the actual titles of maps are also reduced to a minimum, on the lines of the Latin catch-words at the head of the psalms in the prayer-book, becoming thus sometimes ungrammatical.

Mr. Wagner has kept himself abreast of new discoveries of old maps, *e.g.* he knows of the MS. map of Gabriel Tatton found by Caraci at Florence, and is able to reproduce, by permission of Mr. Francis Edwards, the MS. map, ascribed to Edward Wright, sold at Sotheby's in 1928. He holds that Moxon's map of 1655 "was taken from this"—a slightly misleading statement as in certain particulars Moxon's still follows the Molyneux map, with which Mr. Wagner says it has nothing to do. Of a much later date he has been able to study the somewhat elusive charts of Dalrymple at the Huntington Library and elsewhere, and duly notes Dalrymple's English reproduction (1790) of Costanso's Spanish map of 1771. A second issue of the 1799 map is said to bear the original date unchanged, but we believe that the British Museum copy does bear a later date, though in the same year.

Considering the extent of ground covered, mistakes are surprisingly few and

unimportant. Mr. Wagner dates the Ramusio map of the Western Hemisphere 1556, but there seems no doubt that it was at least ready for issue in 1550, while Grande held that it was published in 1553. It is incorrect to say that Girava's map of 1556 was "drawn by Caspar Vopell," it being merely a reduced version based on Vopell's much more important large map, which is not mentioned. The famous Hondius map with the routes of Drake and Cavendish is dated 1595, though since the Society acquired the original portraits which accompanied it, signed by Hondius as made in London, it must be put down as of 1593 at latest. A small slip is the ascription of the Mercator Atlas of 1602 to Hondius, who had not then acquired the plates; and one reads with surprise (p. 126) of the maps of *Thomas* Speed.

Two extensive lists of place-names are next given—of those still in use (including such as have replaced older names since 1800), and those now obsolete—a laborious task for which we may be grateful; and the work ends with a fairly comprehensive bibliography. In this we miss a few items which might have found a place, one being Joseph Moxon's pamphlet of 1697 on the possibility of a Northern Passage. We do find the anonymous "Summary Observations" of 1776 on the same subject, entered under the first word of the title: this is the rule adopted for anonymous publications, the rest being placed alphabetically under authors' names.

Altogether the work is one which no student of early maps can afford to disregard. E. H.

THE BOOK OF BIRDS: the first work presenting in full colour all the major species of the United States and Canada. Edited by GILBERT GROSVENOR and ALEXANDER WETMORE. *Washington, D.C.: National Geographic Society* (1937). Two volumes. $10\frac{1}{2} \times 6\frac{1}{2}$ *inches.* Vol. I, viii+356 *pages;* vol. II, 374 *pages; illustrations and maps.* $5.00

This is claimed to be the first complete work to portray in full colour all the major species of birds of the U.S.A. and Canada. Many authorities have contributed to the descriptions which accompany the plates, and to the chapters introducing them, which are also amply illustrated. The characteristics of each species, its range, breeding habits, and features of its behaviour are set forth; and in the coloured plates the plumage of the females and young birds is depicted when it differs materially from that of the male. It has been possible to arrange the plates to facilitate comparison between eastern and western varieties.

CENTRAL AND SOUTH AMERICA

DER BALKAN AMERIKAS: mit Kind und Kegel durch Mexiko zum Panama-kanal. By COLIN ROSS. *Leipzig: F. A. Brockhaus,* 1937 (2. Auflage). $7\frac{1}{2} \times 5$ *inches;* 274 *pages; illustrations and maps. M.*6 (*unbound M.*4.85)

This is another of the many easily but conscientiously written books of travel which Colin Ross has produced. The present volume deals with his journey from the United States border at Laredo, Texas, southwards to Monterrey. If one cannot agree with the cliché-description of Monterrey as the "Pittsburg of Mexico," one forgives the author when reading his sagacious reflections on the long-discussed Pan-American Highway, which as a whole, "for a long time, if not for ever, will remain a dream," although the stretch from the North American border as far as Panama may be "almost an actuality."

Visiting towns near the Atlantic side of Mexico, the author describes Tamazunchale and Jacala, and the temple remains of San Juan Teotihuacan and the

neighbourhood. Somewhat stereotyped observations on Mexican theology accompany a chapter of history, fair enough but necessarily condensed and not deeply considered; Ross was in Mexico more than twenty-five years ago, and recalls pre-revolution conditions. Agricultural production, he says, is inferior now to what it was in the days of Porfirio Diaz; while the very poor are just as poor as they were prior to Agrarian Reform.

From Mexico City the party proceeded to the Pacific coast regions of Soconusco, thence crossing the Suchiate river into north-westerly Guatemala.

The journey to Panama was, so far as internal evidence goes, no more than a jump from Guatemala; no account of travel in Central America is recorded here, and the notes on Panama are little more than statistical data. The most interesting parts of the book are the pages dealing with observations and reflections on changing conditions, as, for instance, when the author discusses the broad question of "colour" in the Americas.

The reproduction of photos, many of which are new and excellently taken, is not of the best quality; map and chart are notably inadequate. L. E. J.

OCEANIC BIRDS OF SOUTH AMERICA: a study of species of the related coasts and seas, including the American quadrant of Antarctica, based upon the Brewster-Sanford Collection in the American Museum of Natural History. By ROBERT CUSHMAN MURPHY. *New York: The American Museum of Natural History*, 1936. Two volumes. $10\frac{1}{2} \times 8$ *inches*. Vol. I, xxii+640 *pages;* vol. II, 641–1245 *pages; illustrations and maps*

Mr. Murphy's voluminous book is the result of many years' work on South American marine birds. It contains an enormous mass of data referring, some of it rather remotely, to what the author describes as oceanic birds, which are not exactly what English readers expect them to be. Where one looks for a treatise on pelagic birds, it turns out to be a book on marine birds of all habitats. Although they are admittedly arbitrary (p. 326) the restrictions of subject are curious. For example, the oyster catchers are fully described, as they are marine birds, and so is the South Georgia duck, but it is clear that a considerable number of regular winter visitors which also are shore birds, such as Bonaparte's sandpiper and the sanderling, are omitted or only incidentally mentioned. A list of these, if no more, would have been useful.

The section most likely to interest the geographer is entitled "The physical environment." It does not apparently include anything new, but it brings together in one place a substantial body of information referring to South America and its waters, in the widest possible sense. It may be desirable to consider them when dealing with pelagic birds of the Atlantic, but it is faintly surprising to find Ascension, St. Helena, Tristan da Cunha, Gough and Bouvet Islands included in even an ornithological circumnavigation of South America. One cannot help feeling that many pages might have been saved and the utility of the book by no means lessened if a condensed digest of much of the earlier part had been made, and if much introductory matter and detail had been omitted. By so doing the author could have made greatly clearer the connection between physical conditions and the distribution of birds. As it is, Part I contains much which can be found in physiographical text-books and other treatises.

The versions of the Spanish names presumably follow those of the American Geographical Society, but it may be suggested that Mas Atierra is more correctly Más a Tierra and that Talcahauno is not only more prevalent than Talcaguano but more correct.

This book is a very substantial contribution to the biological literature of

South America. It reflects the greatest credit on the industry and energy of the author, who is to be congratulated on his achievement. The illustrations are numerous and good. J. E. H.

AUSTRALASIA AND PACIFIC

I FIND AUSTRALIA. By WILLIAM HATFIELD. *Oxford: University Press (London: H. Milford)*, 1937. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* viii+348 *pages; illustrations.* 7*s* 6*d*

When he was a boy, Mr. Hatfield made up his mind to go to Australia, "see it all," and then "write a book about it that would make the critics take notice." The result is a confident, energetic autobiography covering the years from 1912 to 1936. Its literary merit, in certain respects high and uncommon, can hardly be discussed here, but some of its faults need comment, because they lower the value of what could have been important geographical description. Had the author read more about Australian exploration he would probably have found what he was seeking, and would have been much better equipped for his task. He believes that Burke and Wills (1860–61) opened up the parts of the country best known to him, and seems not at all to appreciate the greater importance of their predecessors, Sturt, Eyre, Mitchell, and Kennedy. He states (p. 319) that he has "never kept a diary or so much as made a note." This reliance on memory and impression makes it hard to trace at all accurately several journeys into parts of the country still almost unknown and, except for his account of them, most inadequately described. And his repeated mis-spelling of names leads one sometimes to question the closeness of his observation and to doubt the validity of his conclusions. His attitude towards his observation and thought is just uncritical enough to bring the geographical level of the book down from that of authority to that of propaganda. He believes, for instance, that the irrigation of certain districts in the interior of Australia would be easy if dams were built at specified points in neighbouring ranges; but his considerations of how much water would be impounded, and of how long it would last, are superficial. His knowledge of the country is enough to justify official examination of his schemes, but one feels that an engineer's report on some of them might be disappointing.

The first quarter of the book (pp. 27–114) is the account of his journey from Adelaide into the pastoral country between the Diamantina and Cooper's Creek, in 1912, and the experience so fulfilled his expectations as to make him a thorough-going "inlander." The most interesting and important parts of the rest of the book, from a geographical point of view, are those dealing with his life in the interior, particularly along the boundary between Queensland and the Northern Territory. His understanding of the blacks, the Afghans, and the cattle-drovers; his feeling for lean country, and his election for life in it, give the book its best qualities. He seems to have no deep feeling for the animals he drove or hunted, but he presents the bush as the inland explorers found it, alive with game one year, parched with drought in another. So long are the time and the distances covered, that the book has a panoramic sweep of view, and one sees change in the country, as the mail coach gives way to the motor lorry; change in the fortunes of the big pastoral and mining companies, as drought and the War come and go. And now, there is an infiltration into the interior, of lonely settlers who are trying to do new things. Hatfield himself intends to "show what mechanical farming would accomplish on land at present used entirely as open grazing country" in North Australia. A bad book would not be worth this attention, but this book is good enough to cause regret that it was not tautened by just a little more real self-criticism. M. A.

FLYING FOX AND DRIFTING SAND: the adventures of a biologist in Australia. By FRANCIS RATCLIFFE. *London: Chatto and Windus*, 1938. 9 × 5½ *inches; 342 pages; illustrations and maps.* 16*s*

Mr. Ratcliffe discusses authoritatively two of Australia's big problems: firstly, that of the giant fruit-eating bats known as "flying foxes," and, secondly, the unending struggle against the remorseless forces of drought, erosion, and sand-drift.

At first glance it appears curious that these entirely unrelated and dissimilar questions should be brought together and discussed under one cover, but the narrative goes much further than a purely scientific discourse on those two problems—it is, on the contrary, an extraordinarily convincing and well-written account of the natural history and human biology of little-known parts of Australia and of the author's reactions to life in the Australian bush. Of the animals and plants and general characteristics of tropical and semi-tropical Australia, his descriptive matter is most interesting, while of the human inhabitants of those regions his observations may well be regarded as a valuable contribution to the anthropological data concerning those little-known people.

Mr. Ratcliffe went to Australia to report on the flying fox—a large, dog-faced, frugivorous bat whose wing span is often little short of 4½ feet. Later he carried out a Governmental investigation into erosion and sand-drift. In the course of his journeys, he covered many thousands of miles, and of those travels he tells of sand-hills and of the lonely desert, of lonely mail routes and flooded rivers, of pelicans and pink cockatoos, and of a humorous, kindly and courageous people "out-back."

In his preface, the author modestly describes his book as being "essentially a collection of observations, impressions and reminiscences on the whole more subjective and trivial than scientific and serious." It is however much more than that and may well be regarded as one of the most readable books yet published on Australian bush life. The book contains many well-produced photographs. O. C. W. F.

A GOLD SEEKER'S ODYSSEY. By LESLIE ROBERT MENZIES. *London: John Long*, 1937. 9 × 5½ *inches; 288 pages; illustrations and map.* 15*s*

Taken as reading matter this book is highly entertaining. It is written in a practised, journalistic style which makes the most of the material. It deals with mining and sporting adventures in New Zealand, Australia, Papua, Japan, Madagascar, and Africa, but by far the greater part is concerned with the Western Australian gold-fields at the time of their most rapid development. Western Australia owes more than it is yet aware to the activities of American whalemen and miners, and needs a history of prospecting; but Western Australia, and the little town of Menzies in particular, may not be satisfied with Mr. Menzies' account of his part in that history, for he claims more than is likely to be acknowledged. The illustration facing p. 148 is entitled "Trans-Australian Train that now passes through the country that the Author explored." Though he doubtless made important prospecting journeys, most difficult to follow on the map from his account of them, Menzies does not rank as one of the explorers of Western Australia, and the part of the State now crossed by the Trans-Australian Railway was effectively explored before the gold-fields were developed. J. S. Battye's 'Western Australia' (Oxford, 1924) states, on p. 415, that "the third remarkable discovery" (of gold) "was made by Menzie and McDonald, experienced men." The town of Menzies, which he always calls Menzies City, was Mr. Menzies' contribution to Western Australia; no small contribution, and it is to be regretted that he has not given us a more

objective and accurate account of it. Memory seems to have played him false, allowing him to be banqueted by a Governor who was not in office at the time (p. 206), and to do an impossible amount of travelling after the banquet, which was in the reign of King Edward VII, but before 1901 (pp. 208–242). It would be wrong however to dismiss the book summarily. Any one who knows Western Australia will admit that Menzies too knows the State well, but his book is so careless that even the railways on the map of Australia facing p. 45 are wrongly shown. M. A.

WIDE HORIZONS: wanderings in Central Australia. By ROBERT HENDERSON CROLL. *Sydney, Australia: Angus and Robertson (London: Australian Book Co.)*, 1937. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* xiv+158 *pages; illustrations and sketch-maps.* 9*s* 6*d*

Based on a series of newspaper and magazine articles, by-products of anthropological research, this book is a review of the attractions and social problems of central Australia, and makes light but informing reading. The author fell under the spell of the desert climate, and writes with an enthusiasm which does not hesitate at superlatives. His descriptions nevertheless have a pleasing definition which may render them useful to regional geographers. He is nearly as interested in birds as in aborigines. Most of the wandering was done by car, on the beaten track, so that the account gives an impression that central Australia is more populous than it is. There are some annoying repetitions of statement in different articles. The half-tone illustrations are admirable, and well chosen. M. A.

TWO LUGS ON A LUGGER. By GEORGE DROMGOLD. *London: Hutchinson & Co.*, [1938]. $8 \times 5\frac{1}{2}$ *inches;* 320 *pages; illustrations* (by James B. Shackelford) *and route-map.* 12*s* 6*d*

The author has written a lively description of his expedition to the South Seas to take photographs for a film production. He and his companion charted a lugger at Thursday Island and sailed for Port Moresby. Most of the book is taken up with an account of their adventures while filming native scenes along the coast of Papua as far as Samarai. It is brightly written and the quality of their work may be judged from the illustrations.

POLAR REGIONS

UNDER THE POLE STAR: the Oxford University Arctic Expedition, 1935–6. By A. R. GLEN, assisted by N. A. C. CROFT. *London: Methuen*, 1937. $10 \times 7\frac{1}{2}$ *inches;* xvi+366 *pages; illustrations and maps.* 25*s*

This is a popular account of the Oxford University Expedition to North-East Land in 1935–6 by the leader and his second-in-command. In these days of such frequent Arctic expeditions it is pleasant to review the narrative of one which not only made fine journeys, but also carried out first-class scientific work. Since an account of the expedition has already appeared in the *Journal*, this is no place to give a précis. There are however several unusual points in the book which call for comment.

It is always difficult to write of an expedition which is split up into several different units, and recently it has become increasingly difficult to find a new method of approach. Both these problems have been well overcome, the second by concentrating on the personal aspect, and more especially on the interactions between the individual members of the party under the unique conditions of the ice-cap stations. In exploration, aim and motive are of great interest, and, from the historical point of view, are often as important as the resulting achievement

or failure. The authors make a praiseworthy attempt to analyse the motives which actuated the members of the party to join the expedition. The result is not wholly satisfying, but there is unusual frankness in dealing with this matter. They also discuss, in some detail, the personal reactions to loneliness and discomfort, and the contrast of the joys and peace of Arctic life alternating with "ice-cap lethargy."

It is good to have a record of many of the small, amusing incidents for which we look in vain in the official accounts of many earlier expeditions. For it is these small and often quite unimportant episodes which are really one of the most characteristic parts of expedition life. The mistakes and incompetence are all too often glossed over, so that an altogether untrue impression of complete efficiency is gained. For this reason the present book gives a much more vivid picture than a more formal narrative could ever do. And even if we think that some of the recorded opinions are perhaps a little peculiar, it must be remembered that they are typical of any youthful modern expedition. In spite of the length of the book the style is such that interest is kept up throughout. Some may feel that there are too many forced metaphors, that uncommon words and phrases are too often used where simpler would have done, but there are frequent passages which do convey a real picture of the beauty of the Arctic.

To most people, the main interest of the book will lie in the description of life at the ice-cap stations. The scientific results were remarkable in themselves, but to the ordinary person the greatest achievement was the establishment of the fact that normal life is possible under such conditions.

Two stations were chipped, passage by passage, room by room, out of the ice. At the central station, for example, a pit was first dug for the tent so that when it was erected only the roof protruded above the surface. Even this was swamped by the rising snow-level until finally only the wireless masts and meteorological instruments remained visible above the surface; life inside became completely independent of blizzard or low temperature outside. Not once did the temperature of the living-tent drop below freezing-point, while the difference inside and out was sometimes as much as 120°. The problem, in fact, was often how to keep the tent cool enough when it became buried under nearly 6 feet of snow. At the central station 12 tons of ice were removed in the total excavations.

Good descriptions are given of the technique of burrowing into the ice and so living warmly, but rather damply, despite the rigours of the climate. Full acknowledgement is made to the assistance derived from the pioneer efforts of Watkins' and Wegener's expeditions to Greenland, but it is clear that the improved technique has now opened the way to unlimited possibilities for research in the future. Very clear sketch-plans and diagrams supplement the descriptions, and these make interesting comparison with similar diagrams of the ice-cap station of the British Arctic Air Route Expedition (*Polar Record*, 1932, p. 69) and of "Eismitte" (Georgi, "Mid Ice," 1934, pp. 92 and 96).

Much detailed information is also given about the equipment and technique of other aspects of the expedition's work, and this illustrates well the great strides which have been made recently in arctic methods. From this point of view alone, the book cannot fail to be of value, but it is surprising to read that in low temperatures fur finneso were lined with the old-fashioned saennegrass instead of the much more convenient duffle linings. Mr. Croft contributes an able discussion on the care and management of dogs. A six-page summary of the scientific work cannot do justice to what was the most comprehensive programme of any British arctic expedition of this century. It is always interesting to compare the results and cost of different expeditions, and a statement of

accounts shows that the expenditure of this one was remarkably small for the work done.

There are a large number of well-reproduced photographs of exceptional quality, and seventeen sketch-maps illustrating the different journeys. On the last of these maps all the routes followed by the expedition have been plotted together, thus indicating how thoroughly the ground was covered. There is also a coloured folding map reprinted from this *Journal*, and a well-prepared index. Altogether it is a vivid narrative which tells much more than just where the party went and what they did; it is worth its high price. B. B. R.

ATLAS OVER ANTARKTIS OG SYDISHAVET. Utgitt av Hvalfangernes Assuranceforening i Anledning av Foreningens 25-Års Jubileum. Redigert av kaptein H. E. Hansen 1936. 16×14 *inches;* 15 *maps,* 2 *tables,* 4 *charts in pocket*

This atlas was published by the Whale-fishery Assurance Company on the occasion of its Silver Jubilee. It is an attractive production in colour, clearly designed, and giving in a simple pictorial form a great deal of information about Antarctica and the southern seas. The main part of the atlas consists of a series of similar maps on a polar projection, each map showing the distribution of a particular subject. There are maps devoted to the routes taken by Norwegian and foreign voyagers; others showing localities where whales have been killed in different months in recent years, and their numbers; others set forth information about the distribution of pack-ice, winds, birds, plants, rock structures, and ocean depths. In addition there are two tables setting out in comparative fashion the distribution of the antarctic and subantarctic flora (flowering plants and mosses) and fauna (birds and seals). A pocket in the cover contains four specially drawn charts covering the whole area between the parallels of 50° and 73° of south latitude. That the atlas covers a wide range of subjects is obvious, and the names of sectional authors such as Olaf Holtedahl and Johan T. Ruud provide further assurance of worth.

Though the atlas is clearly a most informative compilation, it is naturally not entirely free from omissions. There are fifteen maps of the southern continent and oceans, all basically the same; lines of latitude and longitude are marked, but there is no further indication of projection or of scale anywhere between the covers. A map providing information on air temperatures and wind forces shows a number of wind arrows projecting at various points from the continent and Ross Barrier, but none at all from near Adélie Land. More peculiar are the omissions from the maps of a comparative pair, that on the right showing the routes of Norwegian expeditions between 40° S. and the pole, that on the left the routes of foreign expeditions south of 50° S. (The most recent expedition included is Ellsworth's flight of November–December 1935.) Reasons of space doubtless limit the number of routes that can be marked in certain areas, but it is surprising to find the route of the *Jason*, while there is no mention of the Dundee Whalers, nor of Dallman. The tracks of the Norwegian factory ships have been limited to the exploring voyages of the *Odd I*, *Torlyn* and *Thorshavn*. The recent voyages of the *Norvegia* are set out in full, but careful search fails to reveal any trace of the ships of the Discovery Committee, or of Scott and Shackleton (except on land) in the Ross Sea area. G. C. L. B.

INNENFOR DRIVISEN: et år som laege blandt eskimoer. By ARNE HØYGAARD. *Oslo: Gyldendal Norsk Forlag,* 1937. 9×6 *inches;* 188 *pages; illustrations and map.*

This is an agreeable account of some aspects of a year's residence at the settlement of Taseessaq, Angmagssalik, on the east coast of Greenland. The party

under the leadership of Dr. Høygaard consisted of his wife, a small daughter, and two assistants. The purpose of the adult members of the party was to study certain dietetic and bio-chemical problems, particularly those in connection with the presence or absence of vitamin C in the Eskimo diet. In return for facilities provided by the Greenland Administration, Dr. Høygaard offered to act as medical adviser to the district during his stay. This brought him into precisely the kind of contact with the native population which was of most value to him in his experimental work.

The expedition arrived in September 1936 and, owing to exceptional weather conditions, travel in the district was possible right on into November. Dr. Høygaard was called to several settlements where illness had broken out, and in addition to his medical work he was able to carry out scientific tests in various places. The greater part of the winter was spent in conducting experiments in a laboratory erected by the expedition. Some of these consisted in persuading Eskimos to stuff themselves to bursting point or to starve for several days, and naturally enough not all of them could see the point, even though they were paid to do so. In the spring further journeys were made, again for the purpose of collecting scientific data.

Dr. Høygaard seems to have been particularly well equipped for the work he undertook. Previous arctic journeys, including a crossing of the Greenland Ice Cap in 1931 with Martin Mahren, had given him a knowledge of conditions which stood him in good stead when fitting out and conducting his expedition. He has too a real liking for the unspoiled Eskimo and a very considerable capacity for understanding them. Towards the end of the book there are a number of interesting speculations on the future of the East Greenland Eskimo, and on his mentality and outlook compared with that of Europeans. Dr. Høygaard as a father is very much absorbed by the upbringing and education of children, wherein, according to him, the Eskimo is singularly successful. Discipline is unknown, the young Eskimo is surrounded from birth by an atmosphere of love and tenderness and allowed to grow and develop at his own pace.

There are a number of excellent photographs, many of them of children. The scientific results of the expedition will doubtless be published elsewhere.

M. S.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

QUATRIÈME RAPPORT DE LA COMMISSION POUR L'ÉTUDE des terrasses pliocènes et pléistocènes. *Paris: Bureau du Secrétaire Général (de l'Union Géographique Internationale)*, [1934]. 10 × 6½ *inches;* 118 *pages*

This report is in reality a series of research papers on rather divergent topics dealing with a variety of regions in Europe and North America, and to review such a report is not easy. It is hardly satisfactory merely to indicate the scope of the several papers, but on the other hand it is neither possible to review adequately so varied an assemblage, nor desirable to pass arbitrary judgments on communications that have already received proper discussion elsewhere. Those interested will find here accounts of terraces on the Vistula and its Galician tributary the Dunajec, on the Upper Douro, in certain Italian localities, and a summary of recent work on terraces in Italy. They will find also discussions on marine beaches in Florida and California, and a rather interesting account of a method whereby the longitudinal profile of one of the terrace stages of the Susquehanna has been carried downstream through the gorge section in the Piedmont, where no terraces exist. Two accounts of the fluvio-

glacial and other terraces of the Connecticut valley suggest interesting comparisons with similar forms and deposits in Britain which still wait to be investigated. An extended account of W. B. Wright's "Isokinetic theory" will already be familiar to many workers, since it was later published as Chapter XXII of 'The Quaternary Ice Age' (reviewed in the *Journal* for August 1937).

There remain three papers by Briquet on the terraces of the Thames, and on the Quaternary chronology of south-east England and of the Low Countries, all considered in the light of his interpretation of the Somme terraces. Briquet regards our classification of the Thames terraces as being founded upon a misconception, and takes as his fundamental datum the longitudinal profile of the rock-bed upon which the lowest of the Thames gravels rest. Below London this comprises the floor of the buried channel which descends about 100 feet below sea-level at the Nore; above London it is marked by the gravel basement to the modern floodplain. This profile, which current opinion regards as composite, he believes to be a unit, developed in relation to the lowest of the Quaternary base-levels. Above this datum, and ranged in series, with roughly similar downstream gradients, he recognizes some six or seven terrace stages. Terrace 5, for example, is shown as falling from 130 feet at Maidenhead to about 25 feet near Shoeburyness. These terraces are then correlated with stages in the Somme sequence. In the second paper a similar interpretation is offered for the denudation chronology of the Warwick Avon and the Fens, and a tabular correlation of Quaternary events throughout southern England with those of the Somme valley is set out. In the third paper these ideas are pursued further, and applied to the terrace deposits of the Lower Meuse and Rhine. Geologists and geomorphologists in this country may feel somewhat prejudiced against these bold and far-reaching correlations. They will easily detect errors in and omissions from the scheme presented, but this will remain as a challenging alternative to current explanations until it is either disproved or established by a thorough-going re-examination of the problem by British workers.

D. L. L.

DIE VEREISUNGSKURVE. By W. SOERGEL. *Berlin: Borntraeger*, 1937. 10 × 6½ *inches;* 88 *pages; diagram. M.*4.80

It is now about half a century since James Geikie launched upon the world his theory of Interglacial Periods, and James Croll found an astronomical theory to fit the observed phenomena. The effort was undoubtedly premature. Very few geologists were satisfied with the evidence as to the occurrence of interglacial periods, and for many years controversy reigned between the monoglacialists and the interglacialists. That is all settled now. There is ample evidence for two or three complete breaks in the European glaciation, and this periodicity calls for explanation. Moreover, although there are still difficulties in the way of correlating one area with another, it is generally agreed that Penck's succession of Günz, Mindel, Riss and Würm, with three interglacials, Günz-Mindel, Mindel-Riss, and Riss-Würm, will ultimately be found to apply to Europe as a whole. Of these three interglacials Penck proved that the Mindel-Riss was several times longer than the others, and he also showed that the Würm maximum was split by an interstadial, the Laufen oscillation, and had one marked retreat stage called Würm 3 or the Buhl-Stadium.

Now Milankovitch, following Culverwell's treatment of Croll's theory, has recalculated for the past 600,000 years the variations in summer solar radiation due to alteration of excentricity and precession of the equinoxes, and has added thereto the variation due to the cyclic change in the obliquity of the ecliptic, obtaining thus a curve of summer sun-heat, which is most simply

expressed as a change of latitude. If we accept this as justifiable mathematics, and are not appalled by the possibility that the formula is insufficiently accurate to be applied over such a period of time, we are presented with a very passable picture of Penck's independent reading of the Alpine sequence. This Köppen and Wegener pointed out in 1924.

Since that date Professor Soergel, of Freiburg, has been one of the keenest exponents of the theory from the geological side. He sees in it an absolute time-reckoning for the Quaternary, and is even prepared to use it to amplify and make precise the somewhat scrappy geological record. The present work is an attempt to establish what he calls a glaciation curve for the district between longitudes 11 and 19° E. (p. 35), using as a basis Milankovitch's radiation curve but adapting it for such factors as the position of the ice-sheet, and the lag in growth and dissipation of the ice. The result shows some remarkable fits, and some misfits which are overcome with difficulty.

Thus since the last maximum of the Würm, 18,500 years ago (a date which agrees quite well with De Geer's estimate), the curve shows steady amelioration of climate, to about 6000 years before A.D. 1800. It is in this portion of time that the greatest accuracy is to be expected, yet there is no sign of the climatic oscillation marked by the Salpausselkä. The pollen of warmth-loving trees contained in the laminated clays of this moraine may have been introduced from afar. There is however no sign of the definitely postglacial climatic optimum, although this can hardly have occurred more than seven or eight thousand years ago. We should have had more confidence in the earlier portion of the curve if it had recorded these two events.

Because the curve after 18,500 does not show any oscillation to correspond with the Masurian interstadial of the southern Baltic, this latter is relegated to a period before the Würm 3 minimum (Pomeranian moraine). Here the curve rises slightly between the Würm 2 (Weichsel) and Würm 3 minima—a matter of less than 1° of latitude. One may be excused for doubting if this is sufficient. Pursuing the curve farther into the past we find the Laufen oscillation between Würm 1 and Würm 2 has a very marked radiation maximum. The Warthe glaciation of Germany is identified with Würm 1, but this can hardly be proved geologically. One looks for the well-known tripartite subdivision of the Saale or Riss glaciation and it is certainly there, but all the "glaciations" have a similar three minima of radiation.

Of course the main purpose of the work is not to establish the coincidence of the radiation curve with the known facts, but rather, assuming this coincidence in a general way, to indicate in what direction local conditions will modify its effect. The analysis is in many respects interesting, and well worth the consideration of all who have indulged in this dream of the glacialist, an astronomical time reckoning. W. B. W.

ECOLOGICAL ANIMAL GEOGRAPHY: an authorized rewritten edition based on *Tiergeographie auf oekologischer Grundlage*. By RICHARD HESSE. Prepared by W. C. ALLEE and KARL P. SCHMIDT. *New York: John Wiley & Sons—London: Chapman & Hall*, 1937. 9×6 *inches;* xiv+598 *pages; illustrations and maps*. 30*s*

This book is a revision of Hesse's 'Tiergeographie auf oekologischer Grundlage,' published in 1924. The problems of animal geography were approached by Hesse along ecological as opposed to historical lines. Historical zoögeography views the distribution of animals from a study of the inherited resemblances (homologies) of separated groups of animals, and traces through geological time the paths by which modern distribution has been achieved. Such a method

is not open to experimental analysis, and in the records there are inevitable gaps in time and space. Authors have attempted to bridge these with so many hypothetical land connections that almost the entire globe has at one time or another been involved. The ecological approach is through a study of the analogies, or acquired structural and physiological resemblances, between animals in similar habitats throughout the world. Such a method is open to test and experiment since it deals with events which are being continually re-enacted in the present.

This book devotes about equal attention to marine, fresh water, and land animals, so that the sum total of importance of each ecological factor in determining animal distribution is seen in correct, though necessarily broad, perspective. Because the field covered is so wide and is illustrated by such a wealth of examples it is possible to discover occasional statements that are wrong, or the interpretation of which is open to question. Furthermore, because the present book is a revision of an earlier work and is not a new compilation, the task of incorporating the literature since 1924 has not seriously been undertaken. Quantitative community studies are left almost entirely out of the picture. The revising authors chose to make Hesse's work available in English because it is the only work which, on a world-wide scale, applies ecological principles to the problems of animal distribution, and because it contains an extensive digest of European literature, much of which is not easily accessible. Thus while the ecologist may not find this book particularly modern or stimulating, he will at least recognize its value and appreciate the rational and balanced treatment which has resulted from the collaboration of the three authors. D. H. C.

INTERNATIONAL ASPECTS OF OCEANOGRAPHY, OCEANOgraphic data and provisions for oceanographic research. By THOMAS WAYLAND VAUGHAN and others. *Washington, D.C.: National Academy of Sciences*, 1937. 12½×9 *inches;* xviii+226 *pages; charts and diagrams*

This report gives a summary of the oceanographical observations made previous to 1937 and a list of the institutions that make provision for the study of oceanography. It was prepared on behalf of the National Academy of Sciences, Washington, under the instructions of a committee appointed to consider the responsibility of the United States of America towards future work. It is the second publication to arise out of the committee's activities, and follows Dr. Bigelow's 'Oceanography, its scope, problems and economic importance,' published in 1931.

In preparing the summary of oceanographical data Dr. Wayland Vaughan hoped that it would serve as a guide to future research, and although it will not be likely to give any new information to the oceanographer who studies one branch of the science and one region, it will be of very great assistance to one with wider interests, and to any beginner. Separate sections, written by well-known specialists or compiled with expert help, deal with temperature and salinity data, soundings, bottom-deposits, seismological data, gravity determinations, magnetic work and tides. Charts show what observations have been made, and lists of publications show where the data and relevant literature can be found. The charts, and the brief accounts of the recent work bearing on each section, make the book much more valuable than a card-index. It has an emphasis towards the geophysical aspects of oceanography, and work on biological and nutrient salt problems has necessarily been neglected.

The list of oceanographical institutions will not be as useful as the first half of the report, but the information would be very difficult to find elsewhere. The details include history, objects, scope, equipment, staff, income, and

publications. Most of the author's knowledge is first hand; he has either visited the stations himself or received information in manuscript. The activities of the institutions are analysed, but without criticism. Judging from the publications that are sent out Dr. Vaughan is sometimes too generous.

The value of each nation's contribution is not assessed, but it is evident that the United States has some reason to be satisfied. Great Britain holds her own in the Southern Ocean, the Arabian Sea, and in the shallow water round her own coast. G. E. R. D.

ÉTUDE PRATIQUE DES RAYONNEMENTS, SOLAIRE, ATMOSphérique et terrestre. By CH. MAURAIN. *Paris: Gauthier-Villars*, 1937. 10×6½ *inches;* 188 *pages; illustrations.* 80*fr*

In this book the author has set out to give a coherent account of the methods used for the measurement of radiation from the sun, the atmosphere, and the earth, and of the results which have so far been derived by these methods. Instrumental equipment is described in sufficient detail to enable the reader to grasp the physical principles involved in its construction and use, but the details of the reduction of observations will not be found in the book. The author points out that this omission is deliberate. Nevertheless, it would have been interesting to know the precise method by which one arrives at the value of what is known as the "solar constant."

Apart from the details of instrumental methods, the book contains a clear and interesting discussion of the distribution of radiation over the globe, of the spectral distribution of energy in the solar beam, and of the balance of inward and outward radiation through the atmosphere. The discussion of the last-named topic is particularly clear, and sets out in a form which is easy to grasp the items in the earth's balance sheet of energy.

This is a book which will be of particular interest to the meteorologist rather than to the geographer. To the meteorologist, the combination of theoretical and practical considerations will appeal as a valuable addition to the literature of radiation. D. B.

THE MAGNETO-THEODOLITE. *London: H.M. Stationery Office (for the Ordnance Survey)*, 1937. 12×9½ *inches;* 12 *pages+IV plates.* 2*s* 6*d*

The need for a robust field instrument capable of determining magnetic declination rapidly and with really high precision has been apparent for many years. Such an instrument has recently been designed and constructed for the Ordnance Survey.

It has been given the name "magneto-theodolite," and under this title a detailed description has been issued from the Ordnance Survey Department, together with an account of the difficulties which have been overcome, the tests to which the instrument has been subjected, and the uses to which it may be put. The plan is due to Mr. H. L. P. Jolly of the Ordnance Survey staff. In brief, it is to mount a theodolite in conjunction with a suspended magnet in such a way that the orientation of the magnet alternatively with the direction of an object of known azimuth can be read on the horizontal circle with the minimum of adjustment. To obtain free movement of the magnet and at the same time the requisite robustness of mounting, use is made of the "fluid suspension" devised by Sir Frank Smith and first employed, we believe, in the portable magnetometer bearing his name. To obtain rapidly the orientation of the magnet, a "penta-prism" is racked laterally into the theodolite at the axis of rotation. This ingenious scheme enables the observer to view through the ordinary eyepiece and an independent objective permanently mounted at the

axis of rotation, an object at right angles to the line of sight—namely a mirror attached to the magnet—and thus easily to effect auto-collimation with a scale in the focus of the telescope.

The instrument is not in the strict sense "absolute." The original aim of the designer was to make possible by differential methods a rapid intensive survey of an area in which magnetic anomalies were suspected; and it is easily seen how two magneto-theodolites worked in conjunction could accomplish this, each taking the other as an azimuth mark and being moved on from point to point over the area. W. M. W.

ECONOMIC AND HISTORICAL GEOGRAPHY

EINE BONITIERUNG DER ERDE AUF LANDWIRTSCHAFTLICHER und bodenkundlicher Grundlage. By WILHELM HOLLSTEIN. (*Petermanns Mitt. Ergänzungsh.* Nr. 234.) *Gotha: Justus Perthes*, 1937. 11 × 7½ *inches;* 50 *pages; map. M.*9

It is perhaps significant that this monograph should have come out of modern Germany, interested as her present leaders are in a policy of self-sufficiency. The author starts a severe criticism of his fore-runners who have attempted similar work. Penck tried once to solve the question dealt with here by basing his investigations on Köppen's scheme of climatic regions, but was himself aware of the considerable shortcomings of such an undertaking. A. Fischer based his study of the same question on political units, a solution hardly more successful than that of Penck, since it is natural conditions which are the decisive factors in the problem. To get to the root of the matter, according to Hollstein, we have to ask ourselves how far our planet can actually be made use of for cultivation. *Bonitierung* is the assessment of a given soil surface in respect of the possibilities it offers of cultivating various plants of differing values, and the possible harvests obtainable. The three factors, climate, surface conditions, and soil, determine the productivity of any given area, and they are to be considered in this order of importance.

With regard to the first factor, none of the existing classifications of climate is quite satisfactory for the purpose, and individual climatic features, rainfall, temperature, etc., are hardly more useful for an assessment of productivity. Soil types, the distribution of which is also linked up with the question of vegetation formations, are equally useless for the purpose, as varying climatic conditions cause varying productivity on one and the same soil; besides, there is the difficulty that over large areas we have little accurate knowledge of the soil formations. In a similar way, the significance of surface conditions (*i.e.* relief) is subordinate to that of climate.

Ravenstein and A. von Firks used natural vegetation as a measure of land value. But it seems doubtful whether there is any direct connection between wild plant life, and the life of those plants which offer a maximum of nutritive material. A perfectly new procedure is therefore desirable. Leaving aside many factors such as the cultivation of commercial plants and varying intensities of cultivation, the author tries to build up his system on the cultivation of vegetable foodstuff, and the harvests of these which are attainable assuming equally intensive cultivation in all areas. He further modifies these investigations by restricting his attention for the most part to cereals, because they can be grown almost everywhere, though with varying success, and since their growing period is comparatively short. Following Penck, the nutritive significance of a region is then worked out by calorific value, and so the number of people able to exist in that region determined. He tries to take into consideration also

relief conditions, since these may naturally offset the influence of climate and soil. For this purpose he uses a value obtained from the number of *Ernährungstage* and the percentage of arable land, assuming production to extend equally over the whole area concerned and reducing the number of *Ernährungstage* accordingly.

There then follows a detailed description of the twelve types of regions (with sub-regions) which are given on the world map included in the volume. In working out the various types, chief emphasis is laid on the harvest results, expressed calorifically, and not on the type of cereal. The author claims that the very character of the method permits conclusions also to be drawn as to climatic and plant geographical conditions on which so much stress had been laid in earlier works.

The map and the results obtained from it allow calculations to be made as to the possible density of population, and a comparison with actual facts shows that there are regions, notably in China and Java, where a maximum of land-utilization has almost been reached. Comparing conditions prevailing in China and Germany, the author shows the importance of the particular type of land utilization adopted. Owing to the extensive breeding of cattle in Germany, the full calorific value obtainable from the soil is not made use of for the nourishment of the population. But a modification of consumption—carbohydrates instead of fats—tends to influence the utilization factor in that country.

The author ends by working out an estimate of the possible number of people who might find sustenance on this earth. The figure arrived at is 13,295 millions of persons; though not differing considerably from previous estimates, the author asserts that it has now been made accessible to criticism, as it is based on agricultural data and on a large number of items.

The monograph is in short a rather interesting way of looking at old problems, but one questions whether the map finally produced, though well worthy of attention, brings us any nearer to an appreciation of the human carrying capacity of the different parts of the earth's surface. E. C. W.

THE RATIONALIZATION AND CONSERVATION OF THE TIMBER resources of the world. By A. HAROLD UNWIN. *London: The Technical Press*, 1937. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 48 *pages.* 2*s* 6*d*

The problem of unemployment in the Special Areas is a pressing one and any plan that promises to reduce the number of unemployed and improve their conditions of life merits close examination. Dr. A. H. Unwin outlines a scheme for increasing employment in the wood-using and timber-producing industries that is evidently developed in relation to conditions in Great Britain, but may have a wider application in other countries.

The book opens with a discussion of the present condition of private woodlands in England, which in many cases is most unsatisfactory from both silvicultural and economic points of view. This is due in part to neglect of plantations during and after the war and in part to the ignorance of silviculture of many small estate owners. Much work would be provided by thinning and felling plantations, draining, replanting, improvement of fences, destruction of rabbits and the utilization in many possible ways of the timber produced. The author states: "The object is really two-fold. On the one hand, to improve the amenity of the Special Area by care of all the trees and by planting fresh ones, and at the same time arouse the interest and helping the establishment of any wood-using industry. On the other hand, the scheme is to help the rural tree owner to take better care of his trees, make better use of any timber or wood which they produce, and find a further outlet for the best of it." It is suggested

that these objects could be realized by making a survey of the resources of the woodlands adjacent to the Special Areas and eventually of the whole country, training unemployed to carry out the silvicultural and other work revealed as necessary by the survey and the establishment of wood-working trades within the Special Areas. The government should make a grant to set the scheme in operation, but it is intended to become self supporting on a commercial basis within a few years. No doubt much could be done along these lines providing the willing cooperation of the various parties concerned could be obtained. This is not likely to be an easy matter where such a variety of interests are involved. To obtain the cooperation of these interests it is further suggested that a Timber Institute or Wood House should coordinate the activities of the governmental, trade, and professional organizations concerned with timber production and utilization. A list of these is given.

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He reached Egypt in 1818 and three years later was commissioned under English auspices to travel up the Nile. He was able to follow in the wake of Mehemet Ali's victorious army and reached Sennaar. The author has given a summary of Linant's extensive journal, and there is much that is of interest about Shendi, Sennaar, and other towns and villages along the Nile. A further volume is promised which will embody Linant's archaeological notes, and will thus give us after the lapse of more than a century a companion volume to Cailliaud's 'Voyage à Méroé.' In a voyage undertaken in 1827 Linant travelled up the White Nile as far as the Shilluk country. On later occasions he was selected to explore the problem of the Nile sources, but for various reasons these expeditions fell through.

In 1830 Linant was appointed chief engineer of Upper Egypt and the greater part of his working life was henceforward devoted to public works in Egypt. The book throws a very interesting light upon the opening up of a backward country by means of ambitious engineering projects, and is of quite as much importance to the historian and the economist as to the geographer. The Napoleonic expedition of 1798 had inaugurated a splendid tradition of French activity in Egypt, and the arrival of the disciples of the social philosopher, St. Simon, in 1833, reinforced that side of it which sought to make the Nile delta and the isthmus the scene of grandiose engineering operations. Linant's career provides interesting details of how the English and the French opposed each other over schemes for the Barrage and the Canal, for ever fearful of unavowed aims for strategic and commercial advantage. Under the direction of Mehemet Ali and of his successors, Linant Bey produced schemes and surveys,

first for the Barrage, and then for the Canal, and on the appearance of de Lesseps he became his lieutenant.

M. Mazuel's book is a valuable contribution to the history of Egypt's material development during the nineteenth century. G. O. W.

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This book is therefore a study of the relation between literature and experience. Professor Olschki shows for example the relation between the narrative of Marco Polo's journey and the older, imaginary, 'Pilgrimage of Charlemagne to Jerusalem.' Polo's description of the interior of the palace of the Great Khan owes much to such sources. The mention by Columbus of "nightingales" in Haiti, which has puzzled commentators, is shown to derive from similar romantic accounts of the terrestrial paradise. The heroes of these romances conducted themselves in accordance with a definite standard of behaviour, and it is amusing, and illuminating, to find Columbus pleading to be judged as the "Caballero de Conquista" and not as a "Caballero de letras" or Knight of romance. Other themes which Olschki treats thus are Prester John (some of the legends about him are traced to the sixth-century Gregory of Tours); the place of "islands" in this romanticism; the accounts of eastern religions; and Donna Marina, the native princess who figured so prominently in the life of Cortes.

To reconstruct the human geography of the regions of the world at the time they first became known to Europeans requires an understanding of the motives, temperament, and descriptive style of these pioneers; the application of sound critical methods to the corpus of mediaeval geography is therefore much to be desired, and it is to be hoped that Professor Olschki's treatise, which indicates brilliantly the character of the problem, will be followed by other work upon these lines. G. R. C.

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Mr. Baker has added an appendix on the pre-Columbian discovery of America which sets out the arguments on this disputed question succinctly. It is satisfactory to know, from the demand for a second edition, that the value of his work has been recognized. G. R. C.

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THE MONTHLY RECORD

ALPINE TUNNEL METEOROLOGY

Atmospheric conditions in the great railway tunnels of the Alps are discussed by Pierre Brunner in an article in *Der Schweizer Geograph* for December 1937. In the long tunnels, over 6 kilometres, the air is warmer on the average than the outer atmosphere throughout the year—from 15° to 20° C. on cold winter days and 2° to 4° on hot summer days. In the shorter tunnels, 1 to 3 kilometres in length, which are not much affected by earth heat, the air is warmer than the outer air in the depth of winter only. When the Simplon was first pierced a rock temperature as high as 52° C. was recorded; but in the St. Gothard the maximum observed was 31° C., declining to 16° C. at the present time.

The tunnel winds and the conditions of ventilation, natural and artificial, are examined in detail for the nine tunnels over 6 km. in length. The strength and direction of the wind in the tunnels depend on several factors, the more important of which are the air temperature in the tunnel, difference of height and air pressure (reduced to standard level) at the ends of the tunnel, and the relation between the tunnel axis and the trend of the valley. The last factor is most important: ventilation is best when the tunnel axis corresponds most closely with the direction of the valley. Artificial ventilation is employed in long tunnels with weak natural winds or with heavy steam traffic. The large extent to which the Swiss lines have been electrified has however reduced the necessity for artificial ventilation which has been employed at various times in eight tunnels. The St. Gothard was first ventilated by mechanical power in 1899, but ceased to be in 1920 with the coming of electrification. The Mont Cenis has a highly favourable difference of level of 139 metres between its portals, but this chimney effect acts in opposition to the usual flow of air from Savoy to Piedmont, so that a plant to improve circulation was installed in 1903 to be discontinued with the electrification of the line in 1915.

The less familiar Karawanken (8 kilometres) between Carinthia and Slovenia is very badly ventilated by reason of the flat gradient and trend of the axis perpendicular to the Drava and Sava valleys; but an elaborate project for the amelioration of the conditions was abandoned for want of hydraulic power.

In the Simplon powerful forced draughts to-day prevent the air temperature ever rising above 25° C., but in 1912, when the draught was weaker and the rocks hotter, an air temperature as high as 30° C. (86° F.) was recorded. It is stated that dew, hoar-frost, and fog-formation occur in the tunnels, and that humidity conditions vary through the effects of the dripping of water and springs.

VATNAJÖKULL: SWEDISH-ICELANDIC INVESTIGATIONS, 1936–7

The first part of the results of the Swedish-Icelandic work in Iceland, 1936–37, contain four of the ten projected chapters ("Vatnajökull: Scientific results of the Swedish-Icelandic investigations, 1936–37," by H. W:son Ahlmann and Sigurdur Thorarinsson, *Geografiska Annales*, 1937). The first chapter deals with the history, personnel, and organization of the expedition, and contains some useful hints on equipment. The heavy precipitation of snow and annual melting are serious handicaps to travel on the Vatnajökull. A useful and succinct account of the geology and physiography of Iceland follows, and attention is then devoted to the extent of the inland ice during the last glaciation, including the cirques. Chapter III deals in more detail with the morphology and with previous investigations, and contains some important observations

on marginal oscillations. The conclusion is reached that there is striking agreement between glacier oscillations and periodicity in the Vatnajökull and in Spitsbergen, stimulated by similar and approximately contemporaneous climatic variations.

The rock topography is divided into the high plateau, the marginal zone (intersected by valleys), the coastal plain, and the basin zone, reflected in a general manner by the ice surfaces. There have been at least two interglacial periods, and the present rock topography is largely the result of recent tectonic movements and volcanic eruptions. Lastly the Vatnajökull is defined with reference to other present-day Iceland glaciers: the glaciation limit is traced and interpreted with due attention to inland topography and exposure to maritime climate. K. S. S.

KING CHRISTIAN X AND SCIENCE

On the occasion of the celebration of the King of Denmark's twenty-fifth year of reign, Professor Nørlund, under the title of 'The King and scientific research' ('Kongen og den videnskabelige Forskning') recalled the great contribution the various Danish research institutions have made and are making to science generally. Such institutions can only carry out good work if there is stability and peace in the country; that these conditions have been maintained for the last twenty-five years, during which the economic structure of Denmark has been radically altered by reason of the European War, is to some extent due to the personal qualities of King Christian X.

Science has been to an unusual degree blessed in Denmark by the two fine foundations, the Carlsberg Fund and the Rask-Ørsted Fund. Many of the world-famous laboratories and associations have been developed during these twenty-five years: the Institution of Theoretical Physics, the University Physiological Institute, the Mathematical Institute, the new University Library, and various other departments. During the same period the Geodetic Institute, which in geodesy, seismology, and the purely scientific branches of survey has done much enduring work besides the topographical maps of Denmark, Iceland, and Greenland, was formed out of two older departments. The National Museum, with its magnificent archaeological collections, was only housed within the last decade. Another body, closely associated with the government and recently reinforced, especially interesting to geographers, is the Commission for scientific investigations in Greenland. In this as in most scientific activities in Denmark, the King shows a close interest. M. A. S.

THE BADGE OF THE CONSULATE GUARD IN KASHGAR

In our review of the English translation of Mademoiselle Maillart's book 'Forbidden journey,' in the *Journal* for February 1938, it was found hard to believe that the guard at the British Consulate General in Kashgar carried ibex heads as "ornaments" on their caps. We have a letter from Colonel Gordon Loch suggesting that the passage in the original must refer to the ibex head badges of the Gilgit Corps of Scouts, and reference to the French shows that this suggestion is correct. Mademoiselle Maillart wrote "des insignes, têtes de bouquetins en argent, ornent leur bonnet de laine blanche," which has unfortunately been translated as "I noticed they had ibex heads in their white caps."

REPORTED FIND OF NORSE RELICS IN ONTARIO

We have received from Mr. Philip H. Godsell, of Fort Garry, Winnipeg, an account of the finding of what are alleged to be Norse weapons and armour in northern Ontario. These relics were found at various times during the last

three years on the mining claim of Mr. James Dodds, north of the village of Beardmore, 125 miles north-east of Port Arthur. The finds were made by at least four men on various occasions, while "a university professor dug up part of a Viking sword in the same area last year." According to Mr. Dodds, his first find was made as far back as 24 May 1931, but attaching little importance to it, he left it for two years until its value was pointed out to him by Professor Burwash. They then agreed that nothing should be said about it until the articles had been submitted to the examination of competent authorities. The total find consists of a sword, a battle-axe, a shield handle, and pieces of rusted armour.

Largely through the generosity of Mr. Sigmund Samuel, all the relics have been secured for the Royal Ontario Museum. They have now been photographed, and copies submitted to authorities on Norse archaeology in Europe. According to Dr. Currelly, the Director, there is complete agreement that they are of one period, and are to be dated between A.D. 950 and 1000. Professor D. McArthur, Deputy Minister of Education, is preparing a report for submission to the Legislature.

The publication of this report will be awaited with much interest, for in view of the implications of the find it is of the highest importance that its authenticity or otherwise should be determined as soon as possible.

Relics alleged to date from the Norse period have been found from time to time in the area around the Great Lakes. The best known of these is the runic inscription discovered near Kensington, Minnesota, in 1898. The arguments for its authenticity have been strongly urged by Mr. H. R. Holand in 'The Kensington Stone,' Ephraim, Wisconsin, 1932, which was reviewed in the *Journal* for May 1932. This inscription, if genuine, testifies to the presence of a band of Swedes and Norwegians in the region west of the Great Lakes in the year 1362. It will be noted that the finds at Beardmore are said to be nearly four hundred years older than the Kensington inscription and associated relics. The recent find therefore, if correctly dated, opens up a wider problem than that envisaged by Mr. Holand, who linked the inscription with a particular expedition in the fourteenth century. The position of the site may also contribute to the determination of the route followed by these Scandinavian pioneers. Mr. Holand argues that they advanced from Vinland or Greenland through Hudson Strait and Bay and thence by the Nelson and Red Rivers to the Great Lakes. Others have held that Vinland lay in the neighbourhood of Massachusetts, and that the Norse route ran to Lake Erie and thence westwards. The Beardmore find tends to support a route *via* Hudson Bay.

DISCOVERY OF A LAKE IN DUTCH NEW GUINEA

The "Nieuw Guinea Comité" at The Hague have communicated the following details of the discovery of a large inland lake in Dutch New Guinea. While flying south early in 1937 from Seroei, on the island of Japen in Geelvink Bay, to Aika on the south coast, a pilot of the Dutch East Indies air line sighted the lake in the mountainous country west of Mount Carstensz. Its position is estimated as 80 km. north of Mimika, and 150 km. east of Etna Bay. Fifteen kilometres in length, it lies among grass plains about 1600 metres above sea-level, with smaller lakes near by. Comparatively light-skinned people, cultivating attractive gardens, were seen, and about forty canoes fishing on the lake. Some rumours of the existence of this lake had been heard by Dr. Bijlmer during his Mimika expedition of 1935. This discovery is regarded as being of considerable importance for the exploration of the interior, as it is probable that the lake will allow a suitable base for large expeditions to be established by sea-planes.

THE BEACON LAMP OF THE DANISH GEODETIC INSTITUTE

Efforts are continuous to lighten geodetic equipment and reduce the physical labour inseparable from the conduct of triangulation. We already have the Wild and Tavistock theodolites and modern base-measuring apparatus with Invar tapes, the charm of working with all of which compared with the older equipment would make surveyors of bygone days sigh with envy. Now comes the new Beacon lamp of the Danish Geodetic Institute (*Geodaetisk Institut Meddelelse* No. 8), designed specially for the difficult climatic and topographical conditions encountered in the execution of the first order triangulation of Greenland, and particularly valuable in all cases where it is desired to show light from a point to several stations simultaneously. The weather conditions in Greenland permit of only a few days' triangulation in the course of a summer, and to use these days to the best advantage it was necessary to make arrangements for simultaneous observing from six neighbouring stations and to occupy all stations round the observers with lighting parties. The lighting apparatus had therefore to be simple to operate, very light and easily transportable in rough country, and, above all, capable of transmitting a beam of light simultaneously in several different directions.

The essential feature of the apparatus is an ordinary tripod carrying at the top a hollow, vertical, cylindrical rod which is capable of being extended by means of a connecting piece with a further hollow rod. The whole vertical rod can be accurately centred over the station by a plumb-bob hung from a hook under the tripod head. Along the rod, and rotatable about it in any direction, up to six lamps or heliographs can be mounted, each lamp or heliograph having sockets into which a vertical rod mounted on a horizontal arm can fit. This horizontal arm is attached to the principal vertical rod by a screw fastening. The lamp or heliograph with its supporting arm can be turned in any direction about the principal axis, sighting-vanes being fitted along each lamp to give horizontal direction, while vertical direction can be adjusted by a small movement in the short vertical rod which fits into the lamp itself. As the lamps are short to reduce weight, alignment may be facilitated by 6-foot bamboo rods planted a few metres from the lamp in the direction of the sighting-line. The exact point on the bamboo rod through which the light should pass to reach the distant station is marked with a piece of insulating tape.

The lamp is cylindrical with a diameter of 75 mm. and a length of 125 mm., fitted with a silvered parabolic mirror of 70 mm. diameter and focal length of 85 mm. The light source is a Philips 6-volt 15-watt electric head-light bulb placed as accurately as possible at the focus of the mirror. The spread of the beam is about 1 degree. Current is supplied by Ni-Fe accumulators in batteries comprising five cells with a voltage of 6 and a capacity of 20 ampère-hours on a four-hour discharge. Each accumulator is therefore capable of operating the 6-volt 15-watt bulbs for three and a half hours continuously. This is too short a period of illumination, but as weight was a primary consideration it was not possible to carry a heavier battery, and other means had to be devised to increase the period of service of the accumulator. This was secured by interrupting the supply of current to the lamp by means of a mercury switch which was made to oscillate, causing the connection to be intermittent and the beacon lamp to flash. The switch is mounted on a board and fastened to one of the tripod-legs, and by careful adjustment of the angle between the switch and the tripod, or between the mercury switch and the board, the relation between light and dark periods can be regulated. In practice, four seconds' illumination and eight seconds' occultation was followed, and the life of the accumulator extended from three and a half hours to twelve hours.

Intermediate between the battery and the clock switch a board with contact sockets is mounted on another tripod-leg, so that the lights can be put out or switched on as desired, and other lamps can be used for communication between parties. A telegraph key for morse signalling can also be used for operating the lamps should the clock switch fail.

The standard lighting set includes two lamps with two spare bulbs, two heliographs with auxiliary mirrors, accumulator, tripod, switchboard, clock switch, key, cable, and tools. The whole apparatus is beautifully and compactly packed in a rucksack carried on a man's back, and weighs 19·4 kilograms, or 42·8 lb. It is stated that the lamp with tripod, flashing-light, and switchboard can be supplied by Messrs. Brock and Michelson (Copenhagen) at a cost of £7, but it is not clear if this comprises the complete lighting set as enumerated above.

The lamps have been used in Greenland at distances of 100 km. and observations had been made at 40 to 80 km. During two seasons' work the equipment gave complete satisfaction and, in spite of the very rough conditions and its apparent fragility, required only minor repairs.

The whole apparatus constitutes a very valuable addition to geodetic equipment, and is particularly suitable when multiple lights are required from a station and weight is an important factor because of transport difficulties.

J. C. W.

A DUTCH VERSION OF SAXTON'S MAP OF ENGLAND

Only quite lately has adequate attention been given to Saxton's big map of England of 1583, and no copy of the original issue had been known till one was acquired by the British Museum in 1930 (*Geogr. J.* 76 (1930) 86). A second copy, with coats of arms added round the margins, has lately come into the hands of Mr. Francis Edwards. And it seems not to have been recognized that a Dutch version was brought out at Amsterdam in 1644 by the well-known publisher Cornelius Danckertsz, though a copy is preserved at the British Museum in the huge volume presented to Charles II by Dutch merchants at the Restoration. The Society has lately acquired a good copy of a rather later issue bearing the imprint of Dancker Danckertsz: it is undated, but as Cornelius died in 1656, it must be later than this. Cornelius had a son Dancker (the name of a brother also) who seems to have died in 1666, giving a posterior limit for the reprint if it was due to him. It is puzzling to read on the map that the original had *lately* ("nuper") been brought out by the learned Dr. T. Sanson (apparently a mistake for the well-known cartographer Nicholas), but the latter is not known to have published a copy of Saxton's map, nor, in fact, any large map of England at so early a date. It might be thought that the actual model had been the "Quartermaster's" map of 1644, itself copied from Saxton's, but there are details exactly agreeing with the latter, though not with the other. Danckertsz claims to have revised his model, but this seems to apply chiefly to the representations of eastern Ireland and the Isle of Man, which closely follow Speed. A column of letterpress is attached on each side of the map, that on the left bearing the heading "A playn Description of the Kingdom of England," while at the end of all there is a brief description of twenty-one main roads, the source of which we have not yet traced.

E. H.

THE NEWBIGIN PRIZE

The Royal Scottish Geographical Society has asked us to announce that a Bronze Medal and Money Prize will be awarded for the best Essay, suitable for publication in the *Scottish Geographical Magazine* and not exceeding 7000 words, on any subject relating to the geography of Scotland. The essayist

is invited to select his own subject; in future years the range of subject may be prescribed.

Essays, in envelopes marked "Newbigin Prize," must be lodged with the Secretary of the Royal Scottish Geographical Society, Synod Hall, Castle Terrace, Edinburgh, on or before 31 October 1938.

Full particulars regarding the Newbigin Prize will be found in the *Scottish Geographical Magazine*, 1937, p. 270.

OBITUARY

COLONEL SIR W. COOTE HEDLEY, K.B.E., C.B., C.M.G., late R.E.

Colonel Sir Coote Hedley, who died on 27 December 1937 at the age of seventy-two, retired from the Army in 1920, after having held charge of the Geographical Section of the General Staff for nine eventful years. Among his first tasks at the War Office was that of providing for the map requirements of the British Expeditionary Force. This was the first occasion in British history for such provision to be made and it is not surprising that there were some mistakes, though for these Hedley was not responsible. The trouble was of course that the war was expected to be short and "mobile." The relatively small supply of maps that he was ordered to prepare was expected to last "for the duration." No provision was made for an enlarged army or for an enlargement of the theatre of operations, although Hedley himself foresaw the latter possibility and went beyond his official instructions in an endeavour to provide against it. On the contrary, it was thought that when the prepared supplies of maps had been issued the work of the Geographical Section would be finished. When the British Expeditionary Force eventually sailed for France it took with it all of Hedley's officers, leaving him to cope single-handed with the tremendous task of providing an arming nation with maps for a world war. The country was fortunate in having an officer at the War Office so well equipped in ability, knowledge, and experience for dealing with this emergency. Hedley had taken up surveying in 1895 when he joined the Ordnance Survey, and with the exception of an interlude of war service in South Africa, where he served with distinction for two years, being twice mentioned in despatches and receiving a Brevet-Majority, he had been with the Ordnance Survey ever since, acquiring that mastery of the technique of map production for which he was distinguished.

His exceptional knowledge of map printing led to his being chosen, in 1906, to advise the Survey of India on the organization of its map publication offices. The Survey of India was an even older establishment than the Ordnance Survey and in its Headquarter Offices at Calcutta he found methods in use that had grown up slowly from roots planted in the days of Rennell and Everest. His work was not made easier by the fact that the Surveyor-General whom he had to advise was decidedly conservative in temperament. Fortunately Hedley was not only a master of his craft but also a born reformer. In his two years' stay in India he succeeded in getting many beneficial reforms introduced. There can be no doubt that India owes him much. He returned to the Ordnance Survey in 1908 and during the next few years made a special study of colour printing, a study which later on enabled him to devise (probably with the assistance of Mr. Crawford, the Superintendent of Map Printing at the War Office) the layer colouring system adopted at Paris for the Carte Internationale du Monde.

In a short notice it is impossible to do justice to Hedley's work at the War Office during the War. Some idea of its magnitude may be inferred from the fact that the number of new maps produced must have run into thousands, while the numbers printed ran into many millions. In addition he had to find personnel, equipment, and instruments for the new and rapidly expanding survey organization in France and other theatres of war. He it was who sponsored the production of those 1/M maps in which the Society took so large a part and without which the peace negotiations would have been even more difficult and protracted than was actually the case.

One other service deserves special mention. Early in 1915 when visiting the Service Géographique in Paris he saw some experiments in sound ranging, and was so impressed with their possibilities that he broke his return journey at G.H.Q. specially to urge Colonel Jack, who had been his assistant at the War Office and was now in charge of maps at G.H.Q., to have the matter further investigated. It was this recommendation that caused sound ranging, which had been turned down as impracticable by Artillery authorities, to be taken up by the Royal Engineers, with conspicuous success. Hedley claimed no share in this success for himself, for he was the most modest of men. It would have been a long time before a stranger could have discovered from his conversation that he was a master not only of cartography but also of most ball games. He played first-class cricket for many years, mostly for Somerset, was Army champion at rackets, and a scratch golfer: in fact an Admirable Crichton who was yet always ready by example or advice to help and encourage the beginner and the novice. As an official chief Hedley enjoyed in an exceptional degree the esteem, confidence, and affection of his subordinates, perhaps the surest criterion of real worth. But the same thing might have been said of the feelings of all who knew him at all well, for he was straight as a die, considerate, helpful, and efficient. M. N. M.

MEETINGS: SESSION 1937–38

Ninth Evening Meeting, 7 March 1938. The President in the Chair

Elections: Charles Maxwell Allen; Miss Nancy Brimmacombe; Mrs. Marie Cresswell; Pierson John Dixon; Lieut. William Glynne Edwards, R.N.R.; Goriune Thaddeus Gregorian; D. L. Jones, B.SC.; Iain Wilson Lang; Captain Loyd Dearn Price; Sardar Sahib Balbhadra Singh; Milton Frederick Stern; Mrs. Ralph Whitson

Paper: The Pan-American highway project. By M. Hubert Carton de Wiart

Fifth Afternoon Meeting, 14 March 1938. The President in the Chair

Paper: Discussion on the Air Almanac. Opened by the Astronomer Royal

Tenth Evening Meeting, 21 March 1938. The President in the Chair

Elections: James Blake Dalrymple; Miss Rhonda de Rhonda; Miss Alice Empson; Eadric Clifford Fountaine; Sidney Cecil Freeman; Miss Gwendolen Joan Fuller; Reverend Geoffrey Guiton, A.C.P.; Reginald Haidon; George Walter Hayman; Lawrence Hugh McCabe; Captain Thomas Idwal Parry; Stanley Pearson, M.I.C.E.; M. J. Shahani, B.A.; Harry Wilde; Lawrence C. Williamson

Paper: An expedition to Baffin Bay and Arctic Canada in 1937. By Mr. J. M. Wordie

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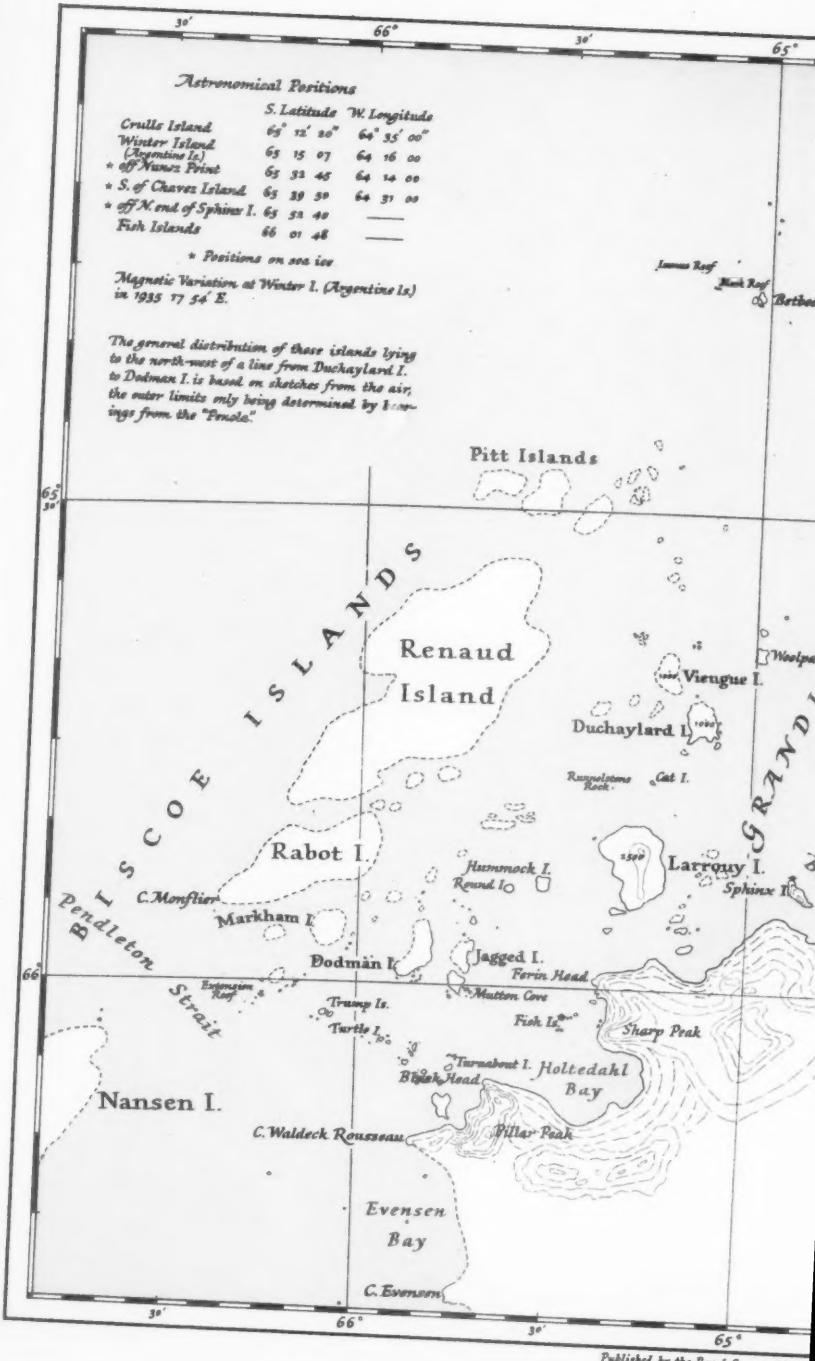
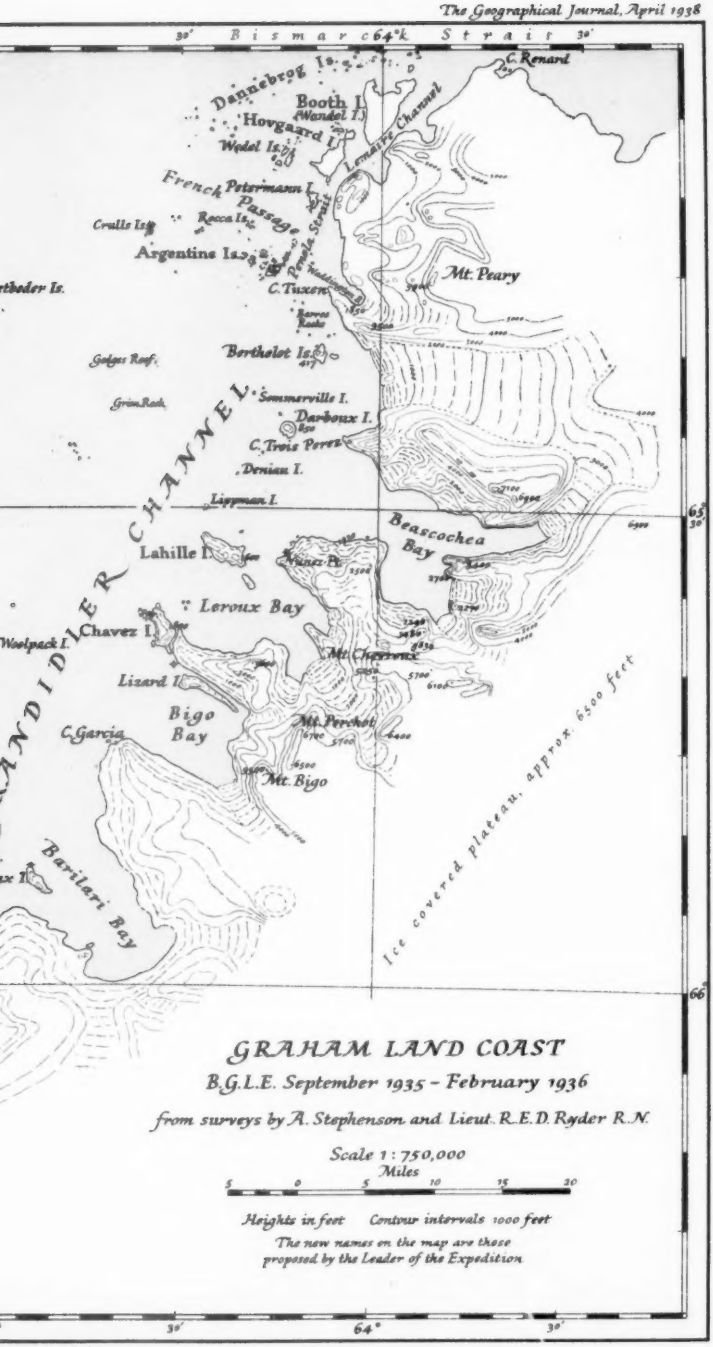

Astronomical Positions
S. Latitude W. Longitude
Crulls Island 65° 12′ 20″ 64° 35′ 00″
Winter Island (Argentine Is.) 65 15 07 64 16 00
* off Nunez Point 65 32 45 64 14 00
* S. of Chavez Island 65 39 30 64 31 00
* off N. end of Sphinx I. 65 52 40 ——
Fish Islands 66 01 48 ——
* Positions on sea ice
Magnetic Variation at Winter I. (Argentine Is.) in 1935 17 54′ E.
The general distribution of these islands lying to the north-west of a line from Duchayland I. to Dodman I. is based on sketches from the air, the outer limits only being determined by landings from the "Fenola."
Pitt Islands
Renaud Island
Vieugue I.
Duchaylard I.
Rumpelstomo Rock
Cat I.
Rabot I.
Hummock I.
Round I.
Larrouy I.
Sphinx I.
C. Monstlier
Markham I.
Dodman I.
Jagged I.
Ferin Head
Mutton Cove
Fish Is.
Sharp Peak
Holtedahl Bay
Turnabout I.
Bleak Head
Nansen I.
C. Waldeck Rousseau
Pillar Peak
Evensen Bay
C. Evensen
Trump Is.
Turtle I.
Evensen Reef
Pendleton Strait
BISCOE ISLANDS
30′
66°
65°

Published by the Royal Geographical



GRAHAM LAND COAST

B.G.L.E. September 1935 – February 1936

from surveys by A. Stephenson and Lieut. R.E.D. Ryder R.N.

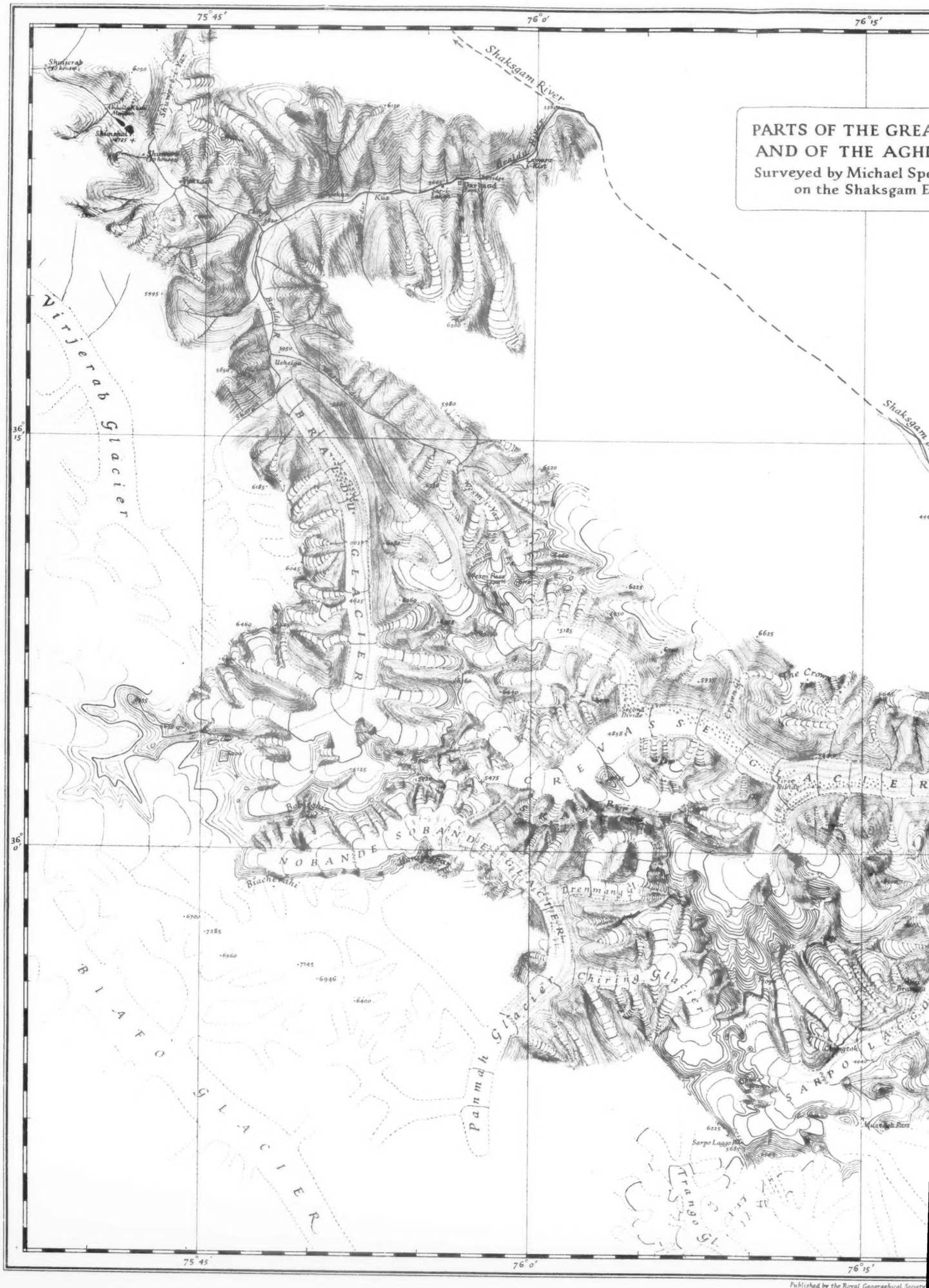
Scale 1 : 750,000

Miles 5 0 5 10 15 20

Heights in feet Contour intervals 1000 feet

The new names on the map are those proposed by the Leader of the Expedition

30' 64° 30'



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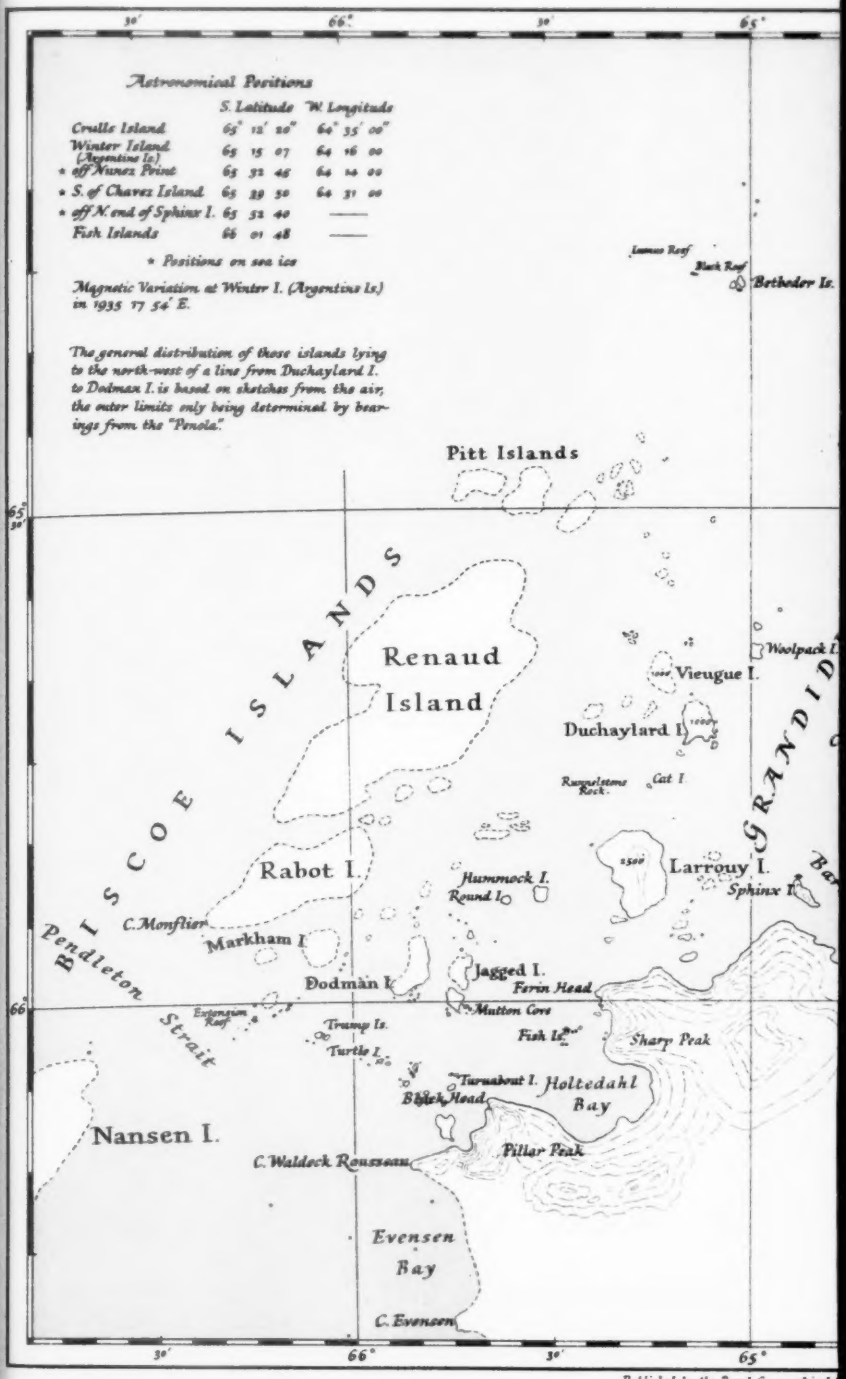
E GREAT KARAKORAM
AGHIL MOUNTAINS

chael Spender and colleagues
ksgam Expedition 1937

SHAKSGAM
Shipton



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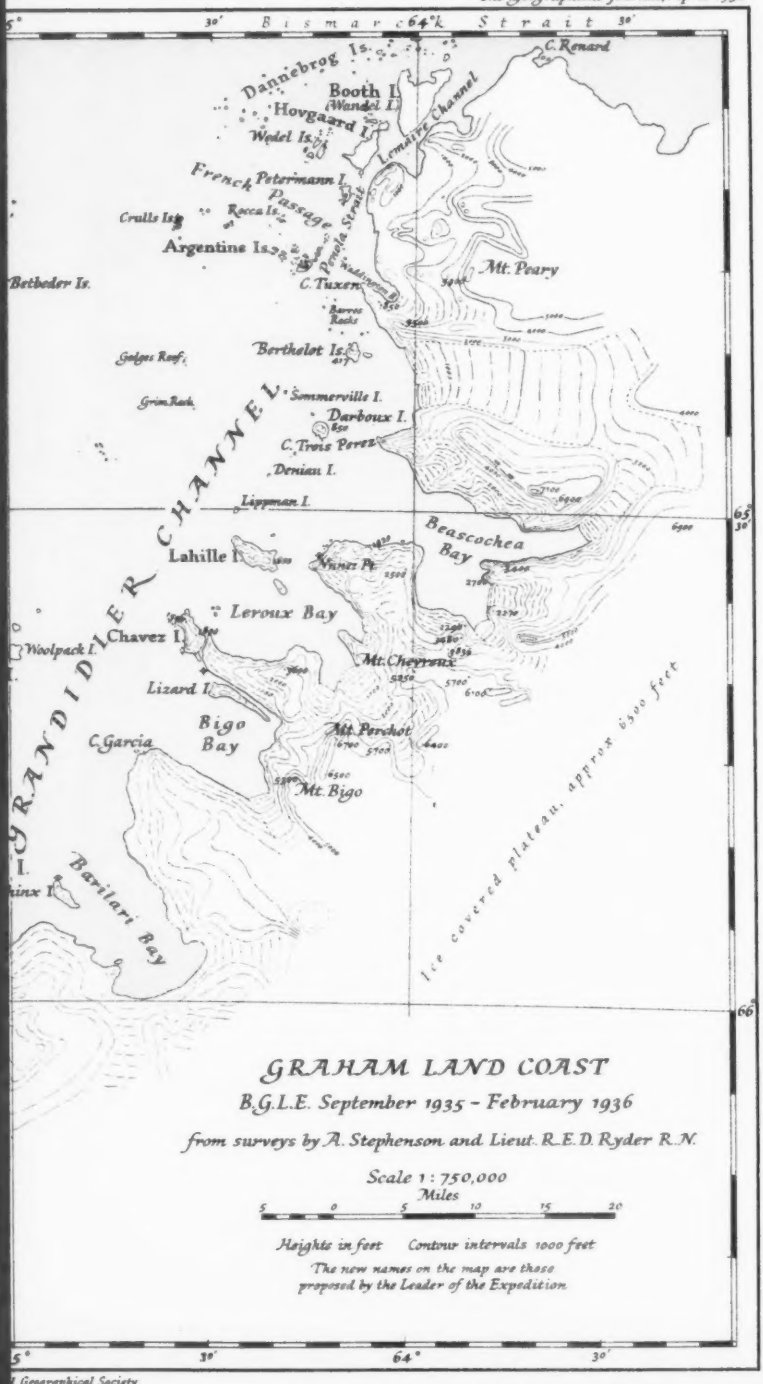

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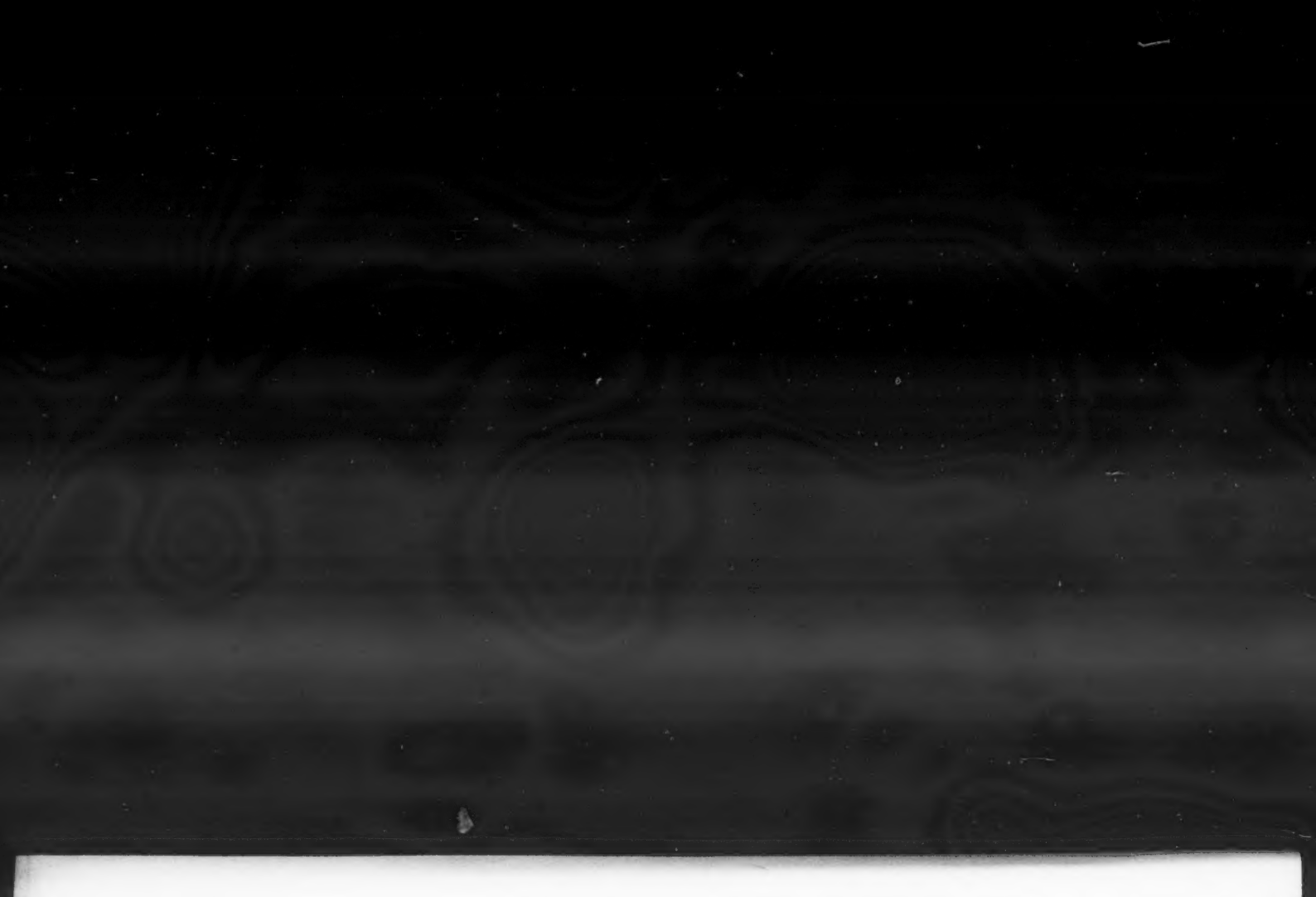
BRITISH GRAHAM LAND EXPEDITION